

2002 Final Report

Cooperative Agreement No. 1448-40181-01-J-002

Status and Distribution of the Snowy Plover in Florida

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¹Please cite this document as follows: Lamonte, K. M., N. J. Douglass, J. G. Himes, and G. E. Wallace. 2006. Status and Distribution of the Snowy Plover in Florida. 2002 study final report. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida, 20 pp. + 15 figs. + 14 tables + 7 appendices.

Introduction

The snowy plover (*Charadrius alexandrinus*) is a small shorebird of coastal sand beaches and lagoons, as well as interior alkali flats and braided river channels. It has a cosmopolitan distribution and is found throughout much of the world's temperate and sub-tropical zones (Page et al. 1995). In North America and the Caribbean, the snowy plover is represented by two subspecies: the western snowy plover (*C. a. nivosus*) of the west coast and interior and western Gulf of Mexico, and the Cuban snowy plover (*C. a. tenuirostris*) of the Gulf of Mexico east of Louisiana, northern Yucatán, and West Indies (AOU 1957, Cramp 1983). While the validity of *C. a. tenuirostris* has been questioned (Blake 1977), there is little doubt that it represents a distinct population. Furthermore, recent genetic research supports the distinction between *C. a. tenuirostris* and *C. a. nivosus*, and further indicates that populations of *C. a. tenuirostris* from the mainland should be recognized as a distinct management unit from populations from the West Indies (S. Haig, pers. comm.).

The great majority of this mainland population of *C. a. tenuirostris* breeds and winters in Florida, where they are restricted to coastal beaches. Florida's breeding birds probably are mostly permanent residents, but there is some evidence that at least a few birds leave the state (J. Gore, pers. comm.). Throughout Florida, snowy plovers are vulnerable to human disturbance, both in the breeding and nonbreeding seasons. Plovers are especially sensitive to disturbance during the breeding season and will avoid or abandon sites that are frequented by people (Gore and Chase 1989). The pace of beach development has not slowed and has increased substantially in parts of the Florida panhandle, where most of Florida's snowy plovers are concentrated.

Loss of nesting habitat and increasing human disturbance has apparently led to a decline in snowy plover breeding populations in the southeast (Imhof 1976, Woolfenden 1978). The last survey specific for snowy plovers in Florida was conducted in 1989: 145 pairs of snowy plovers were found from the Alabama-Florida state line in Escambia County east to Alligator Point in Franklin County, and an additional 22 pairs were found at scattered sites from Three Rooker Bar, Pinellas County south to Marco Island, Collier County (Gore and Chase 1989). Later surveys suggest that the number of breeding birds may be somewhat higher, 170-200 pairs, including approximately 30 pairs on the peninsular Gulf Coast (Gore 1996). Winter counts have presented varying population estimates. A winter count made during a 1988 piping plover (*Charadrius melodus*) survey tallied 215 snowy plovers in Florida (J. Nicholls, pers. comm. in Gore and Chase 1989). The most recent winter count in 2001, also conducted during a piping plover survey, found 311 snowy plovers in Florida (Elliott-Smith et al. 2004).

As a consequence of these very low numbers and the threats of human disturbance and other forms of habitat degradation, the snowy plover is listed as Threatened by the Florida Fish and Wildlife Conservation Commission (FWC). The Florida Committee on Rare and Endangered Plants and Animals considered it endangered (Gore 1996). The U.S. Fish and Wildlife Service (USFWS) has received a petition to list *C. a. tenuirostris* under the Endangered Species Act.

The purpose of this study was to re-assess the status and distribution of the snowy plover in Florida. Specific objectives were to (1) assess the population size and distribution of snowy plovers wintering in Florida, (2) reassess the population size and distribution of snowy plovers breeding in Florida, (3) assess productivity of snowy plovers nesting on Florida beaches, and (4) conduct a review of the literature on *C. a. tenuirostris*.

Methods

Methods employed during this survey followed those utilized by Gore and Chase (1989). Prior to any field work, a literature search was conducted to obtain the most up-to-date information on snowy plover biology, distribution, and census techniques. Methodology utilized by Gore and Chase (1989) was modified as needed based on new findings in the literature. Additionally, survey intensity and frequency were adjusted based on available manpower and distribution of survey locations.

Beginning in January 2002, systematic surveys were conducted of known and potential snowy plover wintering and breeding sites. Locations of known sites were obtained from Gore and Chase (1989), Sprandel et al. (1997), and the 2001 International Piping Plover Census (Kelly and Houser 2001), as well as from local biologists, land managers, and birdwatchers. During the initial survey of each site, site characteristics were recorded and broadly categorized in order to determine the presence and extent of potential wintering and/or breeding habitat (Appendix 1). Site characteristics noted included landform, beach width, type and frequency of anthropogenic disturbance, presence of predators, and presence and extent of dunes, development, tidal pools, and blowouts/sandflats. Sites assessed as having no potential habitat were dropped from subsequent surveys.

Systematic surveys for wintering snowy plovers were conducted between 15 January 2002 and 17 March 2002. Sites were visited once every 3 weeks for a total of 3 survey periods. In a few instances, multiple site visits were conducted within a survey period. The highest number of plovers observed during a survey in that survey period is reported. Surveys were conducted by observers on foot or all-terrain vehicle (ATV). Number and location of snowy plovers were recorded using a GPS receiver, along with activity type (i.e., loafing, feeding, etc.) and location within the beach/dune system (i.e., tidal zone, mid-beach, dunes, etc.). Additionally, number and location of piping plovers (*Charadrius melodus*), Wilson's plovers (*Charadrius wilsonia*), and American oystercatchers (*Haematopus palliatus*) were recorded (Appendix 2). Surveys were concentrated in the Northwest and Southwest regions of the state. Additional surveys were conducted at 1 historic site on the Northeast Atlantic coast and at several important wintering shorebird sites along the Big Bend coast. Due to logistical constraints and some sites being dropped from the survey, not all identified sites were surveyed.

Following the winter site survey, areas were systematically searched for evidence of breeding snowy plovers. Sites without evidence of breeding snowy plovers were dropped from the remainder of the survey. Breeding surveys began 18 March 2002 and continued until 4 August 2002. Each site was visited once every 2 weeks for a total of 10 surveys. For data presentation purposes, the 10 surveys were grouped into 5 – 28 day (i.e., monthly) survey

periods. Surveys were conducted by observers on foot or ATV. Sightings of plovers by observers on ATV were investigated further through searches on foot.

Number and location of breeding snowy plovers were recorded using a GPS receiver. Birds were observed for a short period of time (up to 10 minutes) to determine breeding status. Each bird or pair of birds was placed in one of the following breeding categories: *nesting pair* (an individual or pair of birds actively defending scrapes with eggs), *family* (adults with unfledged chicks), *territorial pair* (a pair of birds defending an area but without nests containing eggs), *territorial single* (a single bird defending an area but without a nest containing eggs), and *loose bird* (birds not associated with any evidence of nests or territorial behavior) (Appendix 3). Number, location, and breeding status of any Wilson's plovers observed during the survey were also noted (Appendix 4).

When snowy plovers exhibited breeding behavior, observers searched on foot for nests. Nests with eggs and/or chicks were assigned an alphanumeric code and marked with a pin flag at a standard offset distance from the nest. Nest location was recorded using a GPS receiver. Nests without eggs (i.e., scrapes) were noted for future investigation but not marked or recorded. On the initial visit, nest contents (i.e., number of eggs and/or chicks) were recorded along with habitat characteristics of the nest site. Features measured included distance to the high tide line, distance to the primary dune line, distance to the nearest vegetation, distance to the nearest structural debris, distance to the nearest building and public access point, nest location in relation to the dune line, and presence of shell or debris in the nest cup (Appendix 5). Each nest was revisited and its contents noted until the fate of the eggs or chicks was determined or until the nest cup was empty.

Chicks were uniquely color-banded whenever possible upon encounter at nests or during surveys in the Northwest region and on one occasion on Sanibel Island in the Southwest region. Each chick was banded with 1 metal USFWS band and 3 Celluloid plastic color bands. Few attempts were made to catch and color-band adults at nests. Observations of color-banded chicks or adults were recorded on later surveys.

To allow for comparison of survey results between years, observations were grouped by local geographic areas coinciding with the boundaries established in Gore and Chase (1989) and by the 2002 survey project investigators. Figure 1 depicts the local geographic areas for northwest Florida and Figure 2 depicts the local geographic areas for southwest Florida in which breeding snowy plovers were found. Further, the number of breeding pairs was used to indicate population size based on the assumptions outlined in Gore and Chase (1989). The assumptions were, "(1) that all birds attempt to re-nest if their clutch fails, (2) that adults with families do not attempt to breed again until after chicks fledge (at least 30 days), and (3) that pairs maintaining a territory are attempting to nest" (Gore and Chase 1989). These assumptions were applicable to the 2002 snowy plover nesting season.

Given these assumptions, the highest number of possible breeding pairs per monthly survey period was calculated using the number of nesting pairs, territorial pairs, and families observed in each local geographic area. The greatest number of breeding pairs recorded in any one monthly survey period was reported as the number of breeding pairs estimated to use that

area in 2002. The 2002 population estimate was the total of the highest number of possible breeding pairs across all local geographic areas. A population estimate that is calculated by this method may be expected to overestimate the actual population size. However, due to the length of time between surveys, the potential to miss well-camouflaged plovers and nests, and the likelihood that breeding pairs observed later in the season were not the same breeding pairs observed earlier in the season, the population estimate is likely the minimum number of pairs present in the 2002 breeding population.

Results

Literature Review

An annotated bibliography for the snowy plover in Florida was prepared and submitted to the USFWS in August 2001 (Appendix 6; Bennett and Wallace 2001). Since that time, several new papers on snowy plovers (both *C. a. nivosus* and *C. a. tenuirostris*) have been published. Those relevant to Florida are listed in Appendix 7.

Initial Habitat Assessment

One hundred eleven sites were identified for inclusion in the 2002 snowy plover survey – 58 sites in the Northwest region, 49 sites in the Southwest region, 1 site in the Northeast region, and 3 sites in the Big Bend region (Table 1). Of those, 86 sites (77%) were initially ranked as wintering snowy plover habitat and 66 sites (59%) were initially ranked as breeding snowy plover habitat. Sixty-one sites (55%) were categorized as both wintering and breeding habitat and 20 sites (18%) were believed to not contain any suitable snowy plover habitat (Table 2).

The vast majority of sites were characterized as sandy beach (n=98) and had beach widths >5m (n=97). Potential predators of snowy plovers were evident at 50% of sites. Most sites (n=87) did not have tidal pools believed to be important nesting and feeding areas and only half (n=54) had dune blowouts or sandflats believed to be important areas for nesting.

The extent of dune habitat, beach development, and human disturbance also were recorded (Table 2). Beach development was continuous or intermittent at 63 sites (57%) and dune habitat was continuous or intermittent at 81 (73%) of sites. Seventy-five sites (68%) had high levels of human disturbance (>20 times per day).

Of the 86 sites ranked as wintering habitat, 12 sites (14%) had continuous development and only 4 (5%) had continuous development and no dune system. Disturbance frequency was >20 times per day at all 12 sites with continuous development and at an additional 28 sites with intermittent or no development. Of the 66 sites ranked as breeding habitat, 6 (9%) had continuous development and only 1 had both continuous development and no dune system. Disturbance frequency was >20 times per day at all 6 sites with continuous development and at an additional 11 sites with intermittent or no development.

While these 3 habitat characteristics are believed to be interrelated and the best indicators of snowy plover habitat, there appeared to be no clear pattern in the use of these factors by surveyors in making an initial determination of wintering and breeding habitat. For example, several sites with continuous development, no dune system, and high levels of disturbance were ranked as breeding and/or wintering habitat, although these factors are thought to preclude use by snowy plovers. These apparent discrepancies may have been the result of overly broad categories for some factors, categories that do not represent the full range of values, and/or inappropriate assignment of site boundaries resulting in non-homogeneous habitat. In many instances, initial habitat determination was likely based on these factors combined with the surveyor's expert judgment and knowledge of the site's historical use by snowy plovers. Final determination of the presence, extent, and quality of wintering and breeding snowy plover habitat was based on these factors, combined with the outcome of winter and breeding surveys and is discussed in the sections below.

Winter Population Size and Distribution

After summing the mean number and averaging the mean density of wintering snowy plovers surveyed from all sites, we determined that a mean total of 288.7 individuals wintered within the state of Florida in 2002, with a mean density of 1.2 plovers per km (Table 3). Wintering snowy plovers were distributed almost exclusively in the Northwest and Southwest regions of the state, with Northwest beaches accounting for 57% of the mean total population. Over 3 survey periods, Southwest region beaches consistently had lower numbers of snowy plovers than Northwest region beaches although the difference was not significant ($t=1.836$, $df=2$, $P=0.208$; Table 4). Surveys at select sites in the Northeast and Big Bend regions of the state documented a total of 1 individual and did not contribute substantially to the statewide winter snowy plover population.

The mean number of wintering snowy plovers recorded in 2002 is consistent with the results of other winter counts of snowy plovers in Florida. A count of snowy plovers during the 2001 International Piping Plover Survey detected 311 snowy plovers in Florida (Elliott-Smith et al. 2004). The majority of those birds also were observed in the Northwest region ($n=207$). A winter count made during a 1998 piping plover survey found 215 snowy plovers in Florida (J. Nicholls, pers. comm. in Gore and Chase 1989).

The 2002 population estimate represents the minimum number of individuals in the winter snowy plover population in Florida. During the non-breeding season, snowy plovers are often found in small flocks but can be solitary and widely dispersed. Single, well-camouflaged birds can be easily missed during surveys. Further, although every effort was made to conduct a comprehensive survey of the winter snowy plover population, some areas with suitable habitat may have been missed. In addition, 3 sites with historic snowy plover records were not surveyed in 2002. These sites were Bunche Beach (Lee County), Sailfish Point Flats (Martin County), and Passage Key National Wildlife Refuge (Manatee).

Among the 111 sites identified for the survey, winter surveys covered a mean of 91 sites (82.0%) along 586 km of Florida coastline. Among the 91 sites surveyed, a mean of 35 sites (38.5%) were occupied by snowy plovers (Table 4). Although the total number of occupied sites

did not fluctuate substantially between survey periods, the sites that were utilized did vary from survey period to survey period. In addition, some birds moved between and used multiple sites. Thus, among the 111 sites identified, snowy plovers collectively utilized 51 different sites (45.9%) over the course of the winter survey – 25 sites in the Northwest region (Figure 3), 25 sites in the Southwest region (Figure 4), and 1 site in the Northeast region (Figure 5). Several sites with historic snowy plover winter records had no documented use during the 2002 survey. These sites included: Big Lagoon State Park, Big Sabine Point/Santa Rosa Island, Camp Creek Inlet to Deer Lake State Park, and Deer Lake State Park (Elliott-Smith et al. 2004).

Several sites contained sizeable portions of the wintering snowy plover population. Five sites supported an average number of snowy plovers that each comprised $\geq 5\%$ of the mean statewide population – St. Joseph Peninsula State Park, St. George Island State Park, Gulf Islands National Seashore/Perdido Key, North Anclote Bar, and Three Rooker Bar (Figure 6). Eight additional sites contained $\geq 5\%$ of the mean statewide population during at least 1 survey – Gulf Islands National Seashore/Santa Rosa, Shell Island, Palm Point, Dog Island, Cayo Costa, Caladesi State Park/Dunedin Pass, Big Hickory Island, and Big Marco Pass Critical Wildlife Area (Figure 6). Only 1 site, St. Joseph Peninsula State Park, supported an average number of snowy plovers that comprised $\geq 10\%$ of the mean statewide population. This site also had the highest number of snowy plovers (40) detected during a survey. St. George Island State Park was the only other site to support $\geq 10\%$ of the mean statewide population during at least 1 survey.

Although the mean number of occupied sites in 2002 ($n=35$) was comparable to the 2001 piping plover winter census results ($n=34$; Elliott-Smith et al. 2004), sites with sizeable portions of the wintering snowy plover population differed between the two years (Figure 7). In 2001, 6 sites had $\geq 5\%$ of the statewide population ($n=16$); four of those sites – St. Joseph Peninsula State Park, Three Rooker Bar, Big Marco Pass Critical Wildlife Area, and Shell Island – had the same proportion of the statewide snowy plover population in 2002. The other large sites in 2001 (Big Sabine Point/Santa Rosa Island and Sanibel Island) had fewer or no snowy plovers in 2002; the same held true for large sites in 2002.

Over the course of the winter survey, 233 snowy plover groups, ranging from 1 to 20 individuals, were observed, with significantly more small groups (≤ 5 plovers) than large groups (> 5 plovers) observed during the 3 survey periods ($t=4.24$, $df=2$, $P=0.051$, Figure 8). The number of observed groups increased during each subsequent survey period from 65 in Survey Period 1 to 92 in Survey Period 3. The proportion of snowy plover pairs also increased from 28% ($n=18$) in Survey Period 1 to 42% ($n=39$) in Survey Period 3, although the proportion was not significantly different between the survey periods ($\chi^2=5.13$, $df=1$, $P=3.84$). This increase in the proportion of pairs in the population coincides with the onset of breeding activity in Florida snowy plovers. It should be noted that 1 pair of plovers was observed at an active nest on 17 February 2002 (i.e., during Survey Period 2). While this might indicate that breeding had begun for the population as a whole, no other nesting pairs were observed in Florida for another month. This early breeding pair appears to be an anomaly. Breeding behavior was not observed in earnest statewide until the end of the 3rd survey period.

Piping plovers, Wilson's plovers, and American oystercatchers were occasionally found at sites containing snowy plovers. Piping plovers were detected at a mean total of 10 sites (28.6%) occupied by snowy plovers during any particular survey period. Overall, 22 sites were utilized by piping plovers throughout the winter survey; 19 of those sites were also utilized by snowy plovers (Table 5). Similar occupancy rates were found in 2001, with 31 sites utilized by piping plovers and 18 of those utilized by both piping and snowy plovers (Kelly and Houser 2001). The larger number of sites used by piping plovers in 2001 was likely due to the focus of the survey on piping plover habitat both within and outside the range of the snowy plover.

Results for Wilson's plovers and American oystercatchers were similar to those for piping plovers. Wilson's plovers and American oystercatchers were detected at a mean total of 9 sites (25.7%) and 7 sites (0.20%), respectively, occupied by snowy plovers during any particular survey period. Overall, 31 and 23 sites were utilized by Wilson's plovers and American oystercatchers, respectively; 19 and 16 of those were utilized by both Wilson's and snowy plovers, and American oystercatchers and snowy plovers, respectively (Table 5).

Breeding Population Size and Distribution

At least 213 breeding pairs of snowy plovers nested or attempted to nest in Florida in 2002 (Table 6). The breeding population was split between the Northwest and Southwest regions of the state, with Northwest beaches supporting 72% of snowy plover breeding pairs.

The 213 snowy plover breeding pairs observed in Florida in 2002 represents a 27.5% increase over the number detected in 1989 ($n=167$; Gore and Chase 1989). Almost all of the increase was attributable to more breeding pairs recorded in the Southwest region in 2002 (Table 7). This apparent increase is very likely the result of increased survey effort in southwest Florida in 2002. During the 1989 survey, select areas along the Southwest coast were surveyed only 1 to 3 times throughout the breeding season (Gore and Chase 1989). During the 2002 survey, Southwest region beaches were visited routinely once every 2 weeks for a total of 10 surveys over the course of the breeding season. However, Little Gasparilla Island and North Captiva Island were only visited once and four times, respectively, due to accessibility problems.

Breeding surveys were conducted at 49 sites statewide, covering 284.8 km of Florida coastline. Snowy plover breeding pairs utilized 22 sites in the Northwest region (Figure 9) and 22 sites in the Southwest region (Figure 10). Four other sites – Alligator Point/Phipps Preserve, Anclote Key State Park South, Lovers Key North, and Caxambas Sandbar – had snowy plover individuals present, but breeding behavior was not observed. Alligator Point/Phipps Preserve and Anclote Key State Park South, along with Grayton Beach State Park, Captiva Island, and Sanibel Island West had historic records of snowy plover nesting but were not utilized by breeding plovers in 2002. In addition, 7 sites with historic snowy plover nesting were not surveyed or were dropped from the survey in 2002 due to unsuitable habitat conditions and/or human disturbance that precluded nesting. These sites were Henderson Beach State Park, Panama City Beach/Developed, St. Andrews State Park, St. Joe Beach, Carrabelle Beach, Egmont Key, and the Sunshine Skyway Bridge.

Several sites contained sizeable portions of the breeding snowy plover population. One site, St. Joseph Peninsula State Park, supported a maximum number of possible breeding pairs $\geq 10\%$ of the statewide breeding population and an additional 6 sites – Shell Island, Tyndall Air Force Base/Crooked Island West, Tyndall Air Force Base/Crooked Island East, St. George Island State Park, Dog Island, and Sanibel Island Central – supported $\geq 5\%$ of the statewide breeding population (Figure 11). Combined, these sites accounted for nearly half (46.5%) of the statewide breeding population.

While the majority of sites with $\geq 5\%$ of the statewide breeding population occurred in the Northwest region, sites with 1 or 2 isolated breeding pairs were more prevalent in the Southwest region. Fourteen (63.6%) of the Southwest region sites supported 1 or 2 snowy plover pairs, while only 5 (23.7%) Northwest region sites supported isolated pairs. The proportion of sites with 1 or 2 breeding pairs was significantly greater in the Southwest region than in the Northwest region ($\chi^2=7.50$, $df=1$, $P\leq 0.01$).

Direct comparison of geographic regions and/or sites was possible only in the Northwest region, where detailed surveys occurred in both 1989 and 2002. While there was no significant difference between the mean number of breeding pairs in the 2002 and 1989 populations ($t=6.314$, $df=1$, $P\geq 0.05$), their distribution amongst sites did change dramatically. The somewhat longer survey period length in 2002 is not believed to have affected detection of breeding pairs. Pairs potentially missed during one survey period presumably would have been detected during subsequent site visits conducted at routine intervals over the entire breeding season. Therefore, comparisons between the 2 survey years should be valid. Comparisons should be made cautiously, though, for areas with few snowy plover pairs (<10), since the gain or loss of even 1 or 2 pairs would constitute a significant proportion of the breeding population at that site.

Almost equal numbers of Northwest geographic regions had increases in snowy plover breeding pairs in 2002 as had decreases: 10 sites had a net loss of breeding pairs and 9 sites exhibited an increase in snowy plover pairs from 1989 levels (Table 8). Several changes are notable, though. Eglin Air Force Base/West, which alone accounted for nearly 25% ($n=38$) of the 1989 statewide population, had $<5\%$ ($n=10$) of the 2002 statewide breeding population. Other high quality nesting areas including Eglin Air Force Base/East, East Pass, Topsail Hill State Park, and Highway 30A Lakes had substantial declines in the number of breeding pairs. While these sites supported smaller numbers of snowy plovers (i.e., <10) in general, the number of breeding pairs was clearly well below 1989 levels. Large increases in the number of snowy plover breeding pairs were documented at several sites as well. Shell Island, Tyndall Air Force Base/Crooked Island East and West, and St. Joseph Peninsula State Park had total numbers of breeding pairs more than double to quadruple the number documented in 1989. Additionally, Dog Island had 11 breeding pairs in 2002, but none recorded in 1989.

When viewed from a regional perspective, areas in the western half of the Northwest region (Escambia, Santa Rosa, Okaloosa, and Walton Counties) had a significantly smaller proportion of the snowy plover breeding population in 2002 than in 1989 when compared to areas in the eastern half of the region (Bay, Gulf, and Franklin Counties; $\chi^2=29.5$, $df=1$, $P\leq 0.001$). While the Bay/Walton county border is a somewhat arbitrary dividing line, it does coincide with the Northwest region's pattern of human development. In both 1990 and 2000, the

closest census years to the survey dates, western counties (Escambia, Santa Rosa, Okaloosa, and Walton) had approximately 75% of the region's human population (U.S. Census Bureau 2005).

Densities of breeding pairs of snowy plovers generally followed the same pattern, with higher densities occurring in the eastern portion of the Northwest region (Figure 12). Two sites, East Pass and Phillips Inlet, again had relatively high densities of breeding pairs, but not as high as in 1989 (Table 9). Both sites were small in size and not linearly distributed as most other survey areas; therefore, a high density calculation may give the impression of a large number of breeding pairs. Comparisons of breeding pair density that include these 2 sites should be done with caution, recognizing the differences in site configuration and numbers of breeding pairs.

Two sites in the Southwest region had a density of at least 2 breeding pairs in 2002: North Lido Beach and Big Marco Pass CWA (Table 10). Because length of beach and thus density of snowy plover breeding pairs were not calculated in 1989 in the Southwest region, direct comparisons cannot be made between 1989 and 2002 in this region. Furthermore, the limited survey effort in the Southwest region in 1989 likely resulted in poor detection rates, rendering direct comparison of the two surveys difficult. The number of sites documented with breeding snowy plovers in 2002 was triple the number of breeding sites in 1989. In 1989, only 7 sites had breeding snowy plovers, compared to 22 sites in 2002 (Table 10). Most of the newly documented 2002 sites supported only 1 or 2 isolated pairs of plovers and would likely have been missed in the more cursory 1989 survey. There was a large number of breeding snowy plovers documented on Sanibel Island in 2002. In 1989, Sanibel Island was believed to be too intensively developed or of the wrong habitat type (i.e., mangrove) to support breeding snowy plovers, and thus no survey of the island was conducted. In 2002, 19 breeding pairs were documented on the island, accounting for 32% of the Southwest region population and 9% of the statewide population. While it is possible that no birds bred on Sanibel Island in 1989, little information exists to confirm this notion. No other formal snowy plover surveys were conducted on Sanibel Island between 1989 and 2002 and no breeding records exist for the intervening years. The secretive behavior of breeding birds, combined with the strong conservation ethic of the local human population on Sanibel Island, may have allowed snowy plovers to thrive on the island without much notice.

Throughout the state, Wilson's plovers were recorded at sites utilized by breeding snowy plovers. Wilson's plovers were documented at 31 sites statewide during the breeding season – 13 in the Northwest region and 18 in the Southwest region (Table 11). At least 20 of those sites were used by breeding Wilson's plovers. Wilson's plovers were in close proximity to breeding snowy plovers at 26 sites (Table 11) and in many cases the two species were observed interacting in a negative manner. In at least 1 instance, an adult Wilson's plover was observed attacking a snowy plover chick and in many instances adult Wilson's plovers and adult snowy plovers were observed fighting each other. In general, adult Wilson's plovers were behaviorally dominant to adult snowy plovers. Consequently, Wilson's plovers occasionally delayed successful nesting attempts by snowy plovers and in some instances the former species caused the latter to attempt to nest elsewhere.

Breeding Chronology

The first snowy plover nest of the 2002 breeding season was located on 17 February on Sanibel Island East. The family group from this nest was first observed 23 days later on 12 March, indicating the nest was laid the week before it was found (assuming a 27-day incubation period). This nest was 6 weeks earlier than the earliest recorded nesting attempt in 1989 (Gore and Chase 1989). The next southwest Florida nest was not found until 14 March, also on Sanibel Island East. A nest was not found in any area off Sanibel Island until 4 April at Charlotte Beach State Recreation Area.

In northwest Florida, the first snowy plover nest was located on 19 March at Gulf Islands National Seashore/Ft. Pickens. However, this was not the earliest nesting attempt in northwest Florida; a newly hatched chick was observed at its nest along with 2 eggs on 27 March, indicating the nest was laid during the last days of February (assuming a 27-day incubation period). The next northwest Florida nests were found on 27 March at St. George Island State Park and Palm Point, and the next family groups were observed 19 April at Shell Island and Palm Point. These dates coincide with the start of nesting in 1989 (Gore and Chase 1989).

The total number of breeding pairs statewide peaked between 15 April and 28 April (Survey Period 4), and then steadily declined throughout the remainder of the breeding season (Figure 13). Southwest Florida breeding peaked during the same survey period, but also had a second peak between 10 June and 23 June (Survey Period 7; Figure 14). The peak in breeding in the Northwest region was the same as statewide, between 15 April and 28 April (Survey Period 4; Figure 14). The timing of this peak in nesting in the Northwest region was the same as occurred in 1989 (Gore and Chase 1989). However, no second peak in nesting activity was observed in the Northwest region in 2002.

Severe storms did not affect Northwest region beaches during the 2002 nesting season (National Hurricane Center 2005). In southwest Florida, a storm between 17 June and 20 June reportedly washed out nests at Sanibel Island, Charlotte Beach State Recreation Area, and Big Marco Pass Critical Wildlife Area. The storm was not, however, a tropical cyclone (National Hurricane Center 2005). However, this storm may account for the sharp drop in the number of nesting pairs and total breeding pairs during the survey period following the storm event (Survey Period 8 – 24 June to 7 July; Figure 15). It may also explain the slight increase in the number of nesting pairs observed during the next survey period (Survey Period 9 – 8 July to 21 July) as birds attempted to re-nest late in the breeding season (Figure 15). The second peak in Southwest region nesting cannot, however, be attributed to the storm event, as this peak coincided with the dates of the storm.

Snowy plover nesting continued in both regions until the middle of July. Nesting pairs were documented in northwest Florida until 11 July and in southwest Florida until 16 July. In 1989, Northwest beaches had nesting snowy plovers into early August, almost a month later than in 2002; Southwest beaches had completed nesting by the beginning of July, slightly earlier than in 2002 (Gore and Chase 1989).

Nesting Habitat

Habitat features were measured at 188 snowy plover nests statewide (Table 12). Of those nests, 127 were located in the Northwest region and 61 were located in the Southwest region. Considerable effort was spent nest searching; however, far fewer nests were located and measured than were suspected present throughout the survey areas. The 2-week survey interval may have contributed to the difficulties finding nests. Assuming a 27-day incubation period, a nest may only have been present during 1 survey period. The nest could have been laid just after a survey or hatched just prior to a survey, leaving only 1 opportunity to document the nest. The snowy plover's cryptic nature often makes finding nests very difficult, particularly with potentially only 1 opportunity.

Nests had similar habitat features in 2002 as they did in 1989 (Table 13). Nests were typically lined with shell, in close proximity (within 1m) to vegetation or debris, and located in view of the water. Mean distances to vegetation and high tide line were also comparable. Two notable differences between years were in nest location and distance of nests to the primary dune line. The proportion of nests located in different areas of the beach was significantly different between 2002 and 1989 ($\chi^2=33.0$, $df=2$, $P\leq 0.001$). Nests were located behind the primary dune 41% of the time in 2002; however, in 1989 only 15% of nests were located in the same area of the beach. The opposite was found for nests located in front of the primary dune. At the same time, nests were on average 3 times farther from the primary dune line in 2002 than in 1989. These differences may indicate development of a more complex dune system (i.e., with primary, secondary, and tertiary dunes) between survey years.

There were also noteworthy differences between habitat features of Northwest region and Southwest region nests in 2002 (Table 14). Overall, Northwest region nests were farther from the primary dune line, more often located behind the primary dune line, or in a dune pocket opening ($\chi^2=94.1$, $df=3$, $P\leq 0.001$), and less often in view of the water. These differences may point to a more complex and intact dune system at Northwest region beaches utilized by snowy plovers.

Additionally, Northwest region nests were about 15 times farther from buildings and approximately 9 times farther from public access points than were those nests in the Southwest region. This indicates that southwest Florida nests occur in more highly developed areas and are potentially subject to greater human disturbance, which may therefore affect nest success. This may affect the spatial distribution of snowy plover nests and may account for the large proportion of Southwest region nests with 1 or 2 isolated breeding pairs.

However, it is not possible to determine if proximity to buildings and/or public access points affected nest success due to the fact that some sites with high use (i.e., many buildings/access points) were posted. The posting of these nests may have mitigated the effect of high human traffic. Further, some nests were located at sites or at areas within sites that had no formal access point or access points many kilometers away. With no access point nearby, these nests may appear to be subject to little human disturbance. However, these sites may in fact have very high levels of human disturbance from boaters accessing these sites by landing their boat anywhere along the shoreline.

Productivity

A total of 193 snowy plover nests were located during the 2002 nesting season – 128 nests in the Northwest region and 65 nests in the Southwest region. We were able to determine the fate of only 81 of the 193 nests (42%) that we found during the survey. For an additional 44 nests, we were able to make an educated guess as to the fate based on adult behavior near the nest territory; however, hatching success could not be definitively determined. The fate of the remaining 68 nests (35%) was unknown.

Tracking the fate of nests proved difficult given the 2-week survey interval in 2002. Nests found with full clutches could have been laid on the survey date or at any time in the 2 weeks prior to that date. If a nest was laid closer to the previous survey period, it would likely hatch prior to the site being surveyed again. Unless evidence was found that the nest hatched (i.e., egg shells at the nest or a family group within the territory), the fate of the nest would be considered unknown. This difficulty with tracking the fate of nests under a 2-week survey interval was also confirmed by the discrepancy between the number of family groups observed and the number of nests with a confirmed fate. Statewide, 162 family groups were observed, but only 81 nests were found and tracked until the fate was known.

Hatching success of the 81 nests of known fate was 73% ($n = 59$). Seventy-five percent ($n=36$) of Northwest region nests of known fate and 70% ($n=23$) of Southwest region nests of known fate hatched successfully. Reasons for nest failure included predation (particularly by raccoons and coyotes), flooding from storms, and trampling by people or crushing by vehicles (ATV or car). Other nests were abandoned after human disturbance or for unknown reasons. The high hatching success rate was likely influenced by 2 factors. First, it was easier to determine the fate of nests that hatched successfully, thereby increasing the proportion of hatched nests counted. And second, some nests in the Northwest region and many in the Southwest region were posted, which may have enhanced hatching success by lessening human disturbance.

In an attempt to determine after-hatching success, 81 hatchlings (67 in the Northwest region, 14 in the Southwest region) and 1 adult snowy plover were uniquely color banded during the survey. Chicks were banded at nests and upon encounter away from nests. Banded snowy plovers were re-sighted on 33 different occasions. Of those, 21 re-sightings resulted in the identification of individual snowy plovers, but 10 of these sightings were of individuals seen previously. The full combination could not be seen or was incorrectly reported for 7 re-sightings, and 4 re-sightings were of birds without unique color markers (silver USFWS band only).

One interesting observation was of a banded snowy plover chick on Sanibel Island that was banded at its nest but was later observed on more than one occasion with banded chicks from another nest. Chick adoption has been documented in other instances, but occurs infrequently (Page et al. 1995). This is the first such instance documented in Florida.

Without additional banded adults and chicks and without knowing the exact origin of banded chicks (since some were banded away from nests), it is not possible to determine

fledging success. However, snowy plovers were believed to have successfully reared second broods in several instances in 2002. Many snowy plover territories had several nests (some as many as 3 nests) throughout the nesting season. Additionally, on several occasions, female plovers were observed incubating a nest in a territory where there were 2 males defending the nest and several chicks. It is believed that these females were re-nesting with a new male while their previous mates remained with the first brood. Without marked adults, it is not possible to know how often mate switching occurs or if it occurs as frequently as in other areas of the country, notably California (Warriner et al. 1986).

Discussion

Winter Population Size

A mean of 288.7 individual snowy plovers wintered, and at least 213 pairs of snowy plovers bred, along the Florida coast in 2002. The number of individuals present in the breeding population is about 1.5 times the winter population, and thus it is probable that a large portion of Florida's breeding population winters outside the state. This is consistent with other estimates of the difference in size between winter and breeding snowy plover populations in the southeastern United States (Gorman and Haig 2002).

It was initially believed that Florida's snowy plover population was partly migratory and partly resident; some breeding birds left the state to winter elsewhere, whereas others spread out to other Florida coastal locations to winter, such as from the Northwest to the Southwest coast (Gore, pers. comm.). During this survey, we found the mean number of snowy plover individuals present in the Southwest region winter population was approximately equal to the number of birds present during the breeding season. At the same time, the mean number of individuals in the northwest Florida winter population was about half the number of individuals present in the region's breeding population. Clearly, a portion of Florida's breeding population, likely from both regions of the state, migrates to wintering sites elsewhere along the Gulf of Mexico. Data compiled by Gorman and Haig (2002) suggest that over half the southeastern U.S. population winters in Mexico and possibly in locations throughout the Caribbean. Elliott-Smith et al. (2004) also suggest some southeastern U.S. birds may winter in the west. A clearer picture of the migratory and wintering habits of snowy plovers in Florida could be gained through more intensive color-marking efforts, expanded survey efforts along potential wintering grounds outside the southeastern U.S., and usage of radiotelemetric techniques.

Another unintended finding of the winter survey was the confirmation of the size of the winter snowy plover population counted during the 2001 International Piping Plover Survey (Elliott-Smith et al. 2004). In 2001, 311 snowy plovers were counted along Florida's beaches, as compared to a mean total of 280 plovers in 2002. Surveys prior to 2001 had documented varying numbers of snowy plovers wintering in Florida (J. Nicholls, pers. comm. in Gore and Chase 1989; Sprandel et al. 1997). Winter population estimates from these surveys were well below the number of birds found in 2001 and 2002. Given 2 consecutive years of data collected using similar survey techniques, we now have more confidence in a winter population estimate of approximately 300 snowy plovers.

Winter Population Distribution

A total of 51 sites statewide were utilized by snowy plovers over the course of 3 winter surveys. On average, though, only 35 of those sites were used during any one survey period. The 35 sites that were used differed from one survey period to another. This leads us to conclude that individual snowy plovers are utilizing multiple sites throughout the winter months. In addition, some individuals may be moving in and out of Florida as they migrate to and from their wintering and breeding grounds. The factors influencing the birds' choice of sites cannot be inferred from the data collected in 2002. Further research is necessary to determine what factors (i.e., habitat type, tide level, etc.) influence plovers' choice of sites. Because snowy plovers use multiple sites throughout the winter season, surveying a limited number of sites only 1 time may not produce an accurate population estimate. Surveys will need to cover all historic snowy plover sites multiple times to ensure adequate sampling of the winter population.

Previous surveys for wintering snowy plovers have concentrated on sites utilized by piping plovers and by large concentrations of wintering shorebirds (Sprandel et al. 1997; Elliott-Smith et al. 2004). While snowy plovers do utilize sites frequented by piping plovers and other shorebird species, snowy plovers seem to use a wider variety of winter locations. Additionally, many sites ranked as important winter shorebird areas based on the presence of large numbers of a wide variety of shorebird species do not coincide with the sites where large concentrations of snowy plovers were found in 2002 (Sprandel et al. 1997). Concentrating survey and protection efforts for snowy plovers only on highly ranked wintering shorebird sites and/or important piping plover areas may miss important winter snowy plover sites.

Breeding Population Size

At least 213 pairs of snowy plovers nested or attempted to nest in Florida in 2002. Due to the substantial increase in survey effort in 2002, the 27.5% increase in number of pairs over those detected in 1989 does not likely represent a true population increase. Based on results for the Northwest region where direct comparison was possible, the size of the snowy plover population appears to have changed little over the last 13 years (Gore and Chase 1989). Although the small difference in survey intervals between 2002 and 1989 was not thought to affect detection of breeding pairs, future surveys using the same survey interval as in 2002 should help detect any trend in population size. Additional surveys should be conducted in future years to reconfirm the size of the statewide breeding population and to better determine the size of the Southwest region population.

Breeding occurred over a 7-month period beginning in February. While not many pairs were found nesting in February, the few that did were several weeks earlier than the earliest recorded nesting pairs in 1989 (Gore and Chase 1989). These dates more closely correspond to the initiation of snowy plover nesting in coastal California and Oregon (Page et al. 1995). It is also several weeks earlier than when other breeding shorebirds (such as Wilson's plover) and seabirds (such as least tern, *Sterna antillarum*, and black skimmer, *Rhynchops niger*) tend to nest. Thus, protection efforts based on traditional shorebird and seabird nesting dates (i.e., April 1 to August 31) do not adequately protect nesting snowy plovers.

Habitat features of snowy plover nests were notably different at Northwest region sites when compared to Southwest region sites. In particular, data collected in 2002 indicate that southwest Florida nests occur along narrower, more intensively developed beaches. This habitat configuration potentially subjects snowy plovers to high levels of human disturbance, which can affect plover use of and nesting success at occupied sites. Unfortunately, productivity proved difficult to track under the survey interval used in 2002 and we were not able to infer from the data any correlations between specific habitat features and nesting success. Additionally, using distance measurements to buildings and access points at sites cannot always be used as an indicator of level of human disturbance at a nest. Many offshore island nesting sites and peninsular locations do not have any development or associated access points; however, these sites are often heavily used by boaters who land their vessels anywhere along the shoreline. This type of access is almost entirely unregulated and the amount of disturbance from people and their pets may be just as great as or greater than near traditional access points.

The high proportion of nests found to have successfully hatched in 2002 may seem to belie the notion that high levels of human disturbance may be affecting the snowy plover. However, these data should be interpreted with caution. The high proportion of nests that successfully hatched is likely due to the fact that hatched nests (i.e., presence of chicks) were easier to confirm than failed nests. More intensive survey efforts will be necessary to accurately determine hatching and fledging success rates, identify the factors that influence nest success, and take appropriate management action.

Breeding Population Distribution

In total, 44 breeding sites were documented statewide in 2002. Six sites account for nearly half of the statewide breeding population, 5 of which occur in the Northwest region. Thus, breeding sites consisting of a large number of plovers are more prevalent in northwest Florida, whereas breeding sites in southwest Florida support mainly 1 or 2 isolated breeding pairs.

In northwest Florida, there appears to have been a major shift in the distribution and density of snowy plover breeding pairs. Areas in the western half of the region, where snowy plovers were concentrated in 1989, had far fewer nesting pairs in 2002. The cause of this shift in distribution and density is unknown. The decrease in the number of breeding pairs in the western Panhandle and the concurrent increase in birds in the eastern Panhandle could be the result of adults moving to areas with more suitable habitat and less human disturbance. Areas in the western portion of the region contain 75% of the region's human population and had a mean increase in population of 30.2% between 1990 and 2000 (U.S. Census Bureau 2005). A second possibility is that the distribution of the population changed as productivity decreased in the western Panhandle and concurrently increased in the eastern Panhandle. Changes in habitat at Eglin Air Force Base and other western sites due to the effects of Hurricane Opal may have decreased habitat suitability for snowy plovers. Further, substantial increases in human recreational use may have impacted the habitat or productivity of snowy plovers. It will be important to monitor the Northwest region population to determine if declines are continuing and the reason for those declines so that appropriate management actions can be instituted. The areas where declines have been found represent a large portion of the total breeding area

available in the Panhandle. If losses continue and plovers are concentrated at fewer sites, this puts increasing pressure on those remaining sites to support the region's snowy plover population.

In southwest Florida, snowy plovers were detected at 3 times the number of sites in 2002 than in 1989. Most of these sites, though, supported only 1 or 2 isolated breeding pairs. These sites could have been easily missed in the earlier survey due to the less intensive survey effort in this region. A large breeding site such as Sanibel Island would have been more difficult to overlook. The substantial increase in number of breeding pairs documented on Sanibel Island in 2002 could be the result of an influx of snowy plovers from elsewhere in the region and may represent recent colonization of this site or may illustrate the inadequacy of the survey techniques used in 1989. Additional surveys using the 2002 survey protocol would yield more conclusive data on Sanibel Island's snowy plover population size.

Management Implications

1. A large portion of Florida's breeding population appears to winter outside of the state. Identification and protection of these wintering grounds will be important to conserving Florida's snowy plover population.
2. Within Florida, wintering snowy plovers are widely dispersed amongst a large number of sites and utilize different sites throughout the winter. In order to adequately monitor the winter snowy plover population, surveys should be conducted multiple times throughout the winter season and at all historic sites.
3. Sites used by wintering snowy plovers differ from sites used by piping plovers and other wintering shorebird species. Focusing protection efforts for snowy plovers on piping plover locations and/or high concentration winter shorebird sites may not adequately protect snowy plovers.
4. Although the size of the Florida's snowy plover breeding population does not appear to have changed substantially in the last 13 years, the population is still small. Breeding surveys should be conducted at more frequent intervals and should follow the 2002 survey protocol in order to detect any changes in population size and distribution. At sites where declines in the snowy plover breeding population have already been documented, further monitoring is needed to determine potential causes of the declines in order to develop and implement appropriate management actions.
5. The eastern half of the Northwest region and Sanibel Island have become increasingly important to Florida's snowy plover population. Protection of these sites will be imperative to maintaining a large portion of the breeding snowy plover population. However, because these sites are few in number, protection of sites elsewhere (e.g., the western half of the Northwest region, and the Southwest Region in addition to Sanibel Island) will be needed to ensure the plover population does not experience declines from which it cannot recover.

6. Compared to other shorebird species on which traditional shorebird nesting protections have been based, the length of the breeding season for Florida snowy plovers is relatively longer, generally spanning from February 15 – August 31. Therefore, we recommend that monitoring programs and management actions cover this range of dates in order to adequately protect breeding snowy plovers.
7. More intensive surveys are needed to determine productivity of snowy plovers. It will be important to determine any differences in productivity at small and large sites, at sites with high and low levels of disturbance, and under different management scenarios (e.g., posted vs. unposted nests). This will help determine if management actions can be implemented to improve productivity at sites with small numbers of breeding pairs and/or with high levels of disturbance.
8. The effects of human disturbance and development on breeding snowy plovers continue to be a concern. These 2 factors are thought to cause declines in the use of sites by snowy plovers, as well as declines in productivity at those sites. Although few privately owned coastal areas remain undeveloped, development should be minimized at important breeding sites and/or concentrated away from areas with breeding snowy plovers. Human disturbance on publicly owned beaches is a much greater concern since the majority of breeding plovers occur on public lands. Snowy plovers that occupy islands are also prone to disturbance by humans accessing the islands by boat. Protection from residential and commercial development, as in the case of Eglin Air Force Base and other sites, does not appear to be enough to safeguard breeding plovers. Minimizing human-related disturbance is imperative to continued successful use of sites by plovers.
9. Raccoons and coyotes were notable snowy plover nest predators, as evidenced by the frequency of their footprints around depredated nests. Ghost crabs may also be major snowy plover nest predators: crab burrows were frequently excavated into active snowy plover nests and in one instance a crab was observed killing a chick (B. Eells, pers. comm.). In addition, fish crows and laughing gulls were observed taking snowy plover eggs (R. Pruner, pers. comm.) and chicks (B. Eells, pers. comm.), respectively. Therefore, predator removal programs may be needed at select sites to enhance breeding success of snowy plovers.
10. The effects of posting individual snowy plover nests are not well understood. On beaches with heavy recreational use, it is assumed that posting reduces the probability that eggs and newly hatched chicks are crushed by pedestrians or vehicles. However, the potential increase in disturbance caused by attracting curious individuals and the extent to which predators learn to key into this visual queue is not understood. The practice is used extensively by well-intentioned managers, but the merits of this management technique urgently need to be assessed in the context of Florida's unique habitats and sound management recommendations developed regarding this practice.

Acknowledgments

Many people contributed to the success of this project. George Wallace initiated this study and trusted us to see it through. Jeff Gore provided guidance and assistance over the course of the project. The following individuals spent many hot, sunny days in the field conducting surveys: Tracey Johnson, John Simon, Brad Smith, Alex Kropp, Lenny Fennimore, Patty Smith, Terry Cannon, Thom Lewis, Gary Sprandel, Terry Doonan, Ricardo Zambrano, Kristen Nelson, Karl Kosciuch, and Pat Leary. The Florida Park Service, the National Park Service, the U.S. Air Force, the U.S. Fish & Wildlife Service, the Apalachicola National Estuarine Research Reserve, the St. Joe Company, the Okaloosa Audubon Society, and the Sanibel-Captiva Conservation Foundation are acknowledged for their cooperation and assistance throughout this study. Amy Croft, Raya Pruner, Jim Rodgers, and Brad Gruver are acknowledged for reviewing an earlier draft of the final report. This study was funded by the U.S. Fish and Wildlife Service and the Nongame Wildlife Trust Fund, Florida Fish and Wildlife Conservation Commission.

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Table 1. Location and description of 111 sites surveyed in 2002 for potential wintering and breeding snowy plover habitat.

Region, Geographic Area, and Site	County	Latitude 1	Longitude 1	Latitude 2	Longitude 2	Size (km)	Alternative Names
Northwest Florida							
<i>Perdido Key West</i>							
Alabama Beach - Developed	Escambia	30 16.805	87 31.071	30 17.268	87 28.786	3.8	
Perdido Key SRA	Escambia	30 17.272	87 28.787	30 17.576	87 27.187	2.6	
Johnson Beach - Developed	Escambia	30 17.560	87 27.176	30 17.865	87 25.160	3.3	
<i>Perdido Key East</i>							
GINS - Perdido Key	Escambia	30 17.865	87 25.160	30 19.855	87 18.961	10.6	Johnson Beach
<i>Big Lagoon</i>							
Big Lagoon SRA	Escambia	30 18.781	87 25.504	30 18.506	87 24.165	2.2	
<i>Fort Pickens</i>							
GINS - Fort Pickens	Escambia	30 19.873	87 17.756	30 19.507	87 10.897	11.0	
<i>Pensacola Beach</i>							
Pensacola Beach	Escambia	30 19.507	87 10.897	30 20.543	87 4.887	9.8	
Santa Rosa Parking Areas	Escambia	30 20.543	87 4.887	30 20.860	87 3.200	2.8	
<i>Santa Rosa</i>							
UWF Property - Santa Rosa Island	Escambia	30 20.860	87 3.200	30 21.077	87 1.958	2.0	
GINS - Santa Rosa	Escambia	30 21.077	87 1.958	30 22.280	86 55.149	11.1	
Big Sabine Point	Escambia	30 21.419	87 2.831	n.f.	n.f.	*	
<i>Navarre Beach</i>							
Santa Rosa Island - Developed	Santa Rosa	30 22.280	86 55.149	30 22.758	86 51.838	5.4	Navarre Beach
Navarre Beach SP	Santa Rosa	30 22.758	86 51.838	30 22.885	86 50.957	1.4	
<i>Eglin West</i>							
Eglin AFB - West	Santa Rosa	30 22.885	86 50.957	30 23.492	86 37.983	20.8	Eglin AFB - Santa Rosa
<i>East end of Eglin West to Beasley Park</i>							
Gulfarium and Condos	Okaloosa	30 23.492	86 37.983	30 23.665	86 35.023	4.8	Fort Walton Beach
<i>Eglin East</i>							
Eglin AFB - East	Okaloosa	30 23.665	86 35.023	30 23.272	86 31.530	5.6	Eglin AFB - Okaloosa
<i>East Pass</i>							
East Pass	Okaloosa	30 23.272	86 31.530	30 23.137	86 30.886	1.1	
<i>Destin to Miramar Beach</i>							
Norriego Point	Okaloosa	30 23.404	86 30.575	30 23.636	86 30.860	0.6	

Table 1. Continued.

Region, Geographic Area, and Site	County	Latitude 1	Longitude 1	Latitude 2	Longitude 2	Size (km)	Alternative Names
Northwest Florida continued							
West Henderson - Developed	Okaloosa	30 22.913	86 30.425	30 23.020	86 27.219	5.1	
Henderson Beach SRA	Okaloosa	30 23.020	86 27.219	30 22.937	86 25.956	2.0	
East Henderson - Developed	Okaloosa	30 22.937	86 25.956	30 22.861	86 24.142	2.9	
Miramar Beach	Walton	30 22.861	86 24.142	30 22.105	86 19.458	7.6	
<i>Topsail Hill</i>							
Topsail Hill Preserve SP	Walton	30 22.105	86 19.458	30 21.306	86 15.798	6.1	Four Mile Village
<i>Highway 30A Lakes</i>							
Stallworth Lake Area	Walton	30 21.306	86 15.798	30 20.504	86 13.065	4.6	Beach Highlands
Stallworth Lake to Big Redfish Lake	Walton	30 20.504	86 13.065	30 20.086	86 11.390	2.8	Dune Allen to Blue Mountain Beach
Grayton Beach SRA	Walton	30 20.086	86 11.390	30 19.273	86 8.737	4.5	
Grayton Beach SRA to Eastern Lake	Walton	30 19.273	86 8.737	30 18.372	86 5.832	5.0	Seaside/Seagrove
Deer Lake SP	Walton	30 18.372	86 5.832	30 17.761	86 4.063	3.1	
Camp Creek to Walton County Line	Walton	30 17.761	86 4.063	30 16.165	85 59.75	7.5	
<i>Philips Inlet</i>							
Philips Inlet/Camp Helen SP	Bay	30 16.165	85 59.750	30 15.909	85 59.130	1.1	Sunnyside
<i>Panama City Beach</i>							
Panama City Beach - Developed	Bay	30 15.909	85 59.130	30 7.991	85 44.745	27.3	
St. Andrews SP - Gulf Front	Bay	30 7.991	85 44.745	30 7.382	85 43.984	1.7	
St. Andrews SP - Kiddie Pool	Bay	30 7.382	85 43.984	30 7.850	85 43.258	1.5	
St. Andrews SP - Grand Lagoon	Bay	30 7.850	85 43.258	30 7.977	85 43.840	1.0	
<i>Shell Island West & East</i>							
Shell Island	Bay	30 7.108	85 43.800	30 3.805	85 37.183	12.3	
<i>Crooked Island West</i>							
Tyndall AFB - Crooked Island West	Bay	30 3.959	85 36.993	30 0.228	85 32.490	10.0	
<i>Crooked Island East</i>							
Tyndall AFB - Crooked Island East	Bay	29 59.566	85 31.660	29 57.998	85 25.838	9.8	
<i>Mexico Beach</i>							
Mexico Beach - Developed	Bay, Gulf	29 57.029	85 25.782	29 53.579	85 21.585	9.3	
<i>Palm Point</i>							
Palm Point	Gulf	29 53.579	85 21.585	29 51.141	85 20.317	5.0	No Name Beach - Oak Grove

Table 1. Continued.

Region, Geographic Area, and Site	County	Latitude 1	Longitude 1	Latitude 2	Longitude 2	Size (km)	Alternative Names
Northwest Florida continued							
Windmark Beach	Gulf	29 51.141	85 20.317	29 50.734	85 19.701	1.2	
<i>St. Joe Bay</i>							
Port St. Joe Beach	Gulf	29 50.173	85 19.011	n.r.	n.r.	*	Highland View
<i>St. Joe Peninsula</i>							
St. Joe Peninsula - Developed	Gulf	29 40.757	85 21.955	29 45.556	85 24.191	9.6	
<i>St. Joseph State Park</i>							
St. Joseph SP	Gulf	29 45.556	85 24.191	29 52.610	85 23.075	13.2	
<i>Cape San Blas</i>							
Cape San Blas	Gulf	29 39.897	85 20.996	29 40.964	85 18.463	4.5	
Indian Pass	Gulf	29 40.964	85 18.463	29 40.979	85 13.337	8.3	
<i>Mainland Shoreline from St. Vincent to Alligator Point</i>							
Yent Bayou	Franklin	29 47.158	84 47.718	29 47.133	84 45.772	3.1	
Carrabelle Beach	Franklin	29 49.849	84 41.063	29 49.828	84 40.760	0.5	
Turkey Point	Franklin	29 54.699	84 29.623	29 54.923	84 29.114	0.9	
<i>St. Vincent NWR</i>							
St. Vincent NWR	Franklin	29 40.853	85 13.057	29 39.424	85 5.245	12.9	
<i>Little St. George Island</i>							
Little St. George Island	Franklin	29 37.624	85 5.558	29 36.791	84 57.516	14.9	
<i>St. George Island - West end</i>							
St. George Island - Developed	Franklin	29 36.852	84 57.452	29 40.969	84 47.811	17.3	
<i>St. George State Park</i>							
St. George Island SP	Franklin	29 40.969	84 47.811	29 45.757	84 41.597	13.4	
<i>Dog Island</i>							
Dog Island	Franklin	29 46.926	84 40.395	29 49.570	84 34.362	10.9	
<i>Lanark Reef</i>							
Lanark Reef	Franklin	29 50.500	84 37.677	29 53.167	84 32.516	9.7	
<i>Phipps Preserve</i>							
Alligator Point - Phipps Preserve	Franklin	29 54.044	84 26.428	29 54.191	84 25.423	1.6	Peninsula Point
<i>Bald Point</i>							
Alligator Point - Developed	Franklin	29 54.191	84 25.423	29 53.628	84 22.474	4.9	

Table 1. Continued.

Region, Geographic Area, and Site	County	Latitude 1	Longitude 1	Latitude 2	Longitude 2	Size (km)	Alternative Names
Northwest Florida continued							
Bald Point SP	Franklin	29 56.828	84 20.586	29 56.732	84 20.254	0.6	
Bald Point - Developed	Franklin	29 53.724	84 22.106	29 54.019	84 20.606	5.6	
Big Bend							
<i>Shired Island</i>							
Shired Island	Dixie	29 23.866	83 12.491	n.r.	n.r.	*	
Cedar Key							
Cedar Key - Tidal mud flats	Levy	29 8.403	83 2.128	n.r.	n.r.	*	
<i>Shell Mound</i>							
Shell Mound - North of Cedar Key	Levy	29 12.402	83 4.156	n.r.	n.r.	*	
Southwest Florida							
<i>North Anclote Bar to south end of North Clearwater Beach</i>							
North Anclote Bar	Pasco	28 13.954	82 50.392	28 13.318	82 50.491	1.2	
Anclote Key SP North	Pasco	28 12.830	82 50.745	28 10.312	82 50.986	4.7	
Anclote Key SP South	Pinellas	28 10.312	82 50.986	28 9.877	82 50.730	0.9	
Three Rooker Bar	Pinellas	28 7.799	82 49.959	28 6.475	82 49.749	2.5	
Honeymoon Island SRA North	Pinellas	28 5.720	82 50.083	28 5.400	82 50.213	0.6	
Honeymoon Island SRA South	Pinellas	28 5.400	82 50.213	28 3.320	82 48.907	4.4	
Caledesi State Park/Dunedin Pass	Pinellas	28 2.990	82 49.025	28 1.176	82 49.645	3.5	
North Clearwater Beach	Pinellas	28 1.176	82 49.645	27 59.890	82 49.719	2.4	
<i>Clearwater Beach to south end of Pass-a-Grille Beach</i>							
Clearwater Beach	Pinellas	27 59.890	82 49.719	27 58.248	82 49.890	3.1	
Pinellas Municipal Beaches	Pinellas	27 57.867	82 49.866	27 41.000	82 44.314	32.5^	
<i>Northwest end of Shell Key to south end of Passage Key</i>							
Shell Key	Pinellas	27 40.558	82 44.499	27 38.985	82 44.312	2.9	Island N of Bunces Pass
Fort DeSoto North	Pinellas	27 38.948	82 44.570	27 37.801	82 44.445	2.1	
Fort DeSoto West	Pinellas	27 37.801	82 44.445	27 36.798	82 44.233	1.9	

Horseshoe Key

Table 1. Continued.

Region, Geographic Area, and Site	County	Latitude 1	Longitude 1	Latitude 2	Longitude 2	Size (km)	Alternative Names
Southwest Florida continued							
Fort DeSoto South	Pinellas	27 36.727	82 44.184	27 37.843	82 42.087	4.0	
Egmont Key	Hillsborough	27 36.126	82 45.813	27 34.593	82 45.364	2.9	
Sunshine Skyway Bridge	Pinellas	27 42.000	82 41.000	27 35.000	82 36.000	15.3	
<i>North end of Anna Maria Island to south end of Siesta Beach</i>							
Anna Maria Island	Manatee	27 32.316	82 44.764	27 26.665	82 41.440	11.8	
Longboat Key North	Manatee	27 26.366	82 41.434	27 23.381	82 38.573	7.7	Beer Can Island
Longboat Key South	Sarasota	27 23.381	82 38.573	27 19.699	82 35.353	8.6	Beer Can Island
North Lido Beach	Sarasota	27 19.546	82 35.295	27 19.001	82 35.180	1.0	
South Lido Beach	Sarasota	27 19.001	82 35.180	27 17.880	82 33.941	2.9	
<i>South Siesta Key to south end of Manasota Key</i>							
Siesta Key	Sarasota	27 16.509	82 34.105	27 14.777	82 32.158	4.5	
Turtle Beach	Sarasota	27 14.141	82 31.569	27 11.151	82 30.076	6.1	Midnight Pass
Casey Key	Sarasota	27 11.151	82 30.076	27 6.733	82 28.132	8.8	
Manasota Key	Sarasota	27 6.658	82 27.932	26 55.375	82 21.646	23.3	
<i>Stump Pass State Park to Gasparilla North</i>							
Charlotte Beach SRA	Charlotte	26 54.602	82 21.142	26 53.305	82 20.391	2.7	Stump Pass
Don Pedro Island	Charlotte	26 53.706	82 20.402	26 50.400	82 18.050	7.2	Knight Island - Palm Island Resort
Little Gasparilla Island	Charlotte	26 50.400	82 18.050	26 48.940	82 16.884	3.3	
Gasparilla North	Charlotte	26 48.663	82 16.884	26 45.575	82 15.920	5.9	
<i>Gasparilla South</i>							
Gasparilla South	Lee	26 44.279	82 15.833	26 43.271	82 15.839	1.9	
<i>Cayo Costa to south end of North Captiva Island</i>							
Cayo Costa	Lee	26 42.309	82 15.290	26 36.784	82 13.355	10.7	
North Captiva Island	Lee	26 36.200	82 13.434	26 34.152	82 12.304	4.2	
<i>Captiva Island</i>							
Captiva Island	Lee	26 33.104	82 12.075	26 28.980	82 11.050	7.8	
<i>Sanibel Island to Big Hickory Island</i>							
Sanibel Island West	Lee	26 28.959	82 10.994	26 28.113	82 10.325	1.9	
Sanibel Island Central	Lee	26 27.838	82 9.922	26 25.319	82 4.806	9.7	
Sanibel Island East	Lee	26 25.319	82 4.806	26 27.192	82 0.810	7.5	

Table 1. Continued.

Region, Geographic Area, and Site	County	Latitude 1	Longitude 1	Latitude 2	Longitude 2	Size (km)	Alternative Names
Southwest Florida continued							
Fort Myers Beach	Lee	26 27.903	81 58.117	26 24.964	81 54.309	8.3	
Little Estero Island	Lee	26 24.964	81 54.309	26 24.222	81 53.082	2.5	Little Estero CWA
Lovers Key North	Lee	26 24.193	81 52.694	26 23.246	81 52.533	1.8	
Lovers Key South	Lee	26 23.246	81 52.533	26 22.757	81 52.193	1.1	
Big Hickory Island	Lee	26 22.711	81 52.055	26 21.996	81 51.712	1.4	
<i>Bonita Beach to Naples</i>							
Bonita Beach	Lee	26 21.922	81 51.776	26 19.873	81 50.773	4.1	
Barefoot Beach	Collier	26 19.726	81 50.681	26 17.360	81 49.882	4.6	
<i>Keywadin Island to Cape Romano</i>							
Keywadin Island	Collier	25 59.480	81 45.070	n.r.	n.r.	1.7	
Big Marco Pass CWA	Collier	25 57.377	81 45.238	25 56.683	81 44.579	1.7	Marco Island - Tigertail Beach
Caxambas Sandbar	Collier	25 54.295	81 43.211	25 54.297	81 47.628	7.4	
Cape Romano Large Sandbar	Collier	25 50.323	81 40.155	25 50.812	81 39.763	1.1	Cape Romano Morgan Beach
Cape Romano Small Sandbar	Collier	25 50.812	81 39.763	n.r.	n.r.	*	
Sea Oat Island	Collier	25 0.979	81 0.740	n.r.	n.r.	*	
Northeast Florida							
<i>Little Talbot</i>							
Little Talbot Island SP	Duval	30 29.036	81 25.341	30 27.563	81 24.715	2.9	

* Site was too small to have meaningful linear distance calculated.

^ Distance from the northernmost public beach to the southernmost public beach. Only the public beaches, not the areas in between, were surveyed.

n.r. = not recorded

Table 2. Initial assessment of 111 sites for potential wintering and breeding snowy plover habitat.

Region, Geographic Area, and Site	Potential		Potential Breeding Habitat?	Extent of Development*	Extent of Dune System*	Disturbance Frequency	Extent of Habitat ^a
	Wintering Habitat?						
Northwest Florida							
<i>Perdido Key West</i>							
Alabama Beach - Developed	N		N	C	A	>20	N
Perdido Key SRA	Y		Y	A	C	>20	C
Johnson Beach - Developed	N		N	C	A	>20	N
<i>Perdido Key East</i>							
GINS - Perdido Key	Y		Y	I	C	5-20	C
<i>Big Lagoon</i>							
Big Lagoon SRA	Y		N	I	A	>20	I
<i>Fort Pickens</i>							
GINS - Fort Pickens	Y		Y	A	C	5-20	C
<i>Pensacola Beach</i>							
Pensacola Beach	N		N	C	A	>20	N
Santa Rosa Parking Areas	Y		Y	I	C	>20	I
<i>Santa Rosa</i>							
UWF Property - Santa Rosa Island	Y		Y	A	C	5-20	C
GINS - Santa Rosa	Y		Y	I	C	5-20	C
Big Sabine Point	Y		N	A	A	5-20	I
<i>Navarre Beach</i>							
Santa Rosa Island - Developed	N		N	C	I	>20	N
Navarre Beach SP	Y		Y	I	C	<5	C
<i>Eglin West</i>							
Eglin AFB - West	Y		Y	I	C	<5	C
<i>East end of Eglin West to Beasley Park</i>							
Gulfarium and Condos	N		N	C	I	>20	N
<i>Eglin East</i>							
Eglin AFB - East	Y		Y	I	C	>20	I
<i>East Pass</i>							
East Pass	Y		Y	A	C	>20	C
<i>Destin to Miramar Beach</i>							
Norriego Point	Y		Y	A	I	>20	I

Table 2. Continued.

Region, Geographic Area, and Site	Potential		Potential Breeding Habitat?	Extent of Development	Extent of Dune System	Disturbance Frequency	Extent of Habitat*
	Wintering Habitat?						
Northwest Florida continued							
West Henderson - Developed	N		N				N
Henderson Beach SRA	Y		Y	I	C	>20	C
East Henderson - Developed	N		N	C	A	>20	N
Miramar Beach	N		N	C	A	>20	N
Topsail Hill							
Topsail Hill Preserve SP	Y		Y	A	C	>20	C
Highway 30A Lakes							
Stallworth Lake Area	N		N	C	A	>20	N
Stallworth Lake to Big Redfish Lake	N		N	C	A	>20	N
Grayton Beach SRA	Y		Y	A	C	>20	I
Grayton Beach SRA to Eastern Lake	N		N	C	A	>20	N
Deer Lake SP	Y		Y	I	I	>20	I
Camp Creek to Walton County Line	Y		Y	C	I	>20	I
Philips Inlet							
Philips Inlet/Camp Helen SP	Y		Y	A	I	>20	C
Panama City Beach							
Panama City Beach - Developed	N		N	C	A	>20	N
St. Andrews SP - Gulf Front	Y		Y	A	C	>20	C
St. Andrews SP - Kiddie Pool	Y		N	A	I	>20	I
St. Andrews SP - Grand Lagoon	Y		N	A	A	>20	I
Shell Island West & East							
Shell Island	Y		Y	I	C	>20	C
Crooked Island West							
Tyndall AFB - Crooked Island West	Y		Y	A	C	5-20	C
Crooked Island East							
Tyndall AFB - Crooked Island East	Y		Y	A	C	>20	I
Mexico Beach							
Mexico Beach - Developed	Y		N	C	I	>20	N
Palm Point							
Palm Point	Y		Y	I	C	5-20	C

Table 2. Continued.

Region, Geographic Area, and Site	Potential		Extent of Development	Extent of Dune System	Disturbance Frequency	Extent of Habitat*
	Wintering Habitat?	Potential Breeding Habitat?				
Northwest Florida continued						
Windmark Beach	Y	N	A	I	5-20	I
St. Joe Bay	N	N	A	A	5-20	N
St. Joe Peninsula	Y	N	I	I	>20	I
St. Joe Peninsula - Developed	Y	Y	A	C	5-20	C
St. Joseph State Park	Y	Y	I	I	>20	I
St. Joseph SP	Y	Y	C	I	>20	I
Cape San Blas	Y	N	I	A	<5	C
Cape San Blas	Y	N	A	I	5-20	C
Indian Pass	Y	Y	A	I	<5	C
Mainland Shoreline from St. Vincent to Alligator Point	Y	N	A	I	5-20	C
Yent Bayou	Y	Y	A	I	<5	C
Carrabelle Beach	Y	N	A	I	5-20	C
Turkey Point	Y	Y	A	C	<5	C
St. Vincent NWR	Y	Y	A	C	5-20	I
St. Vincent NWR	Y	Y	A	C	5-20	I
Little St. George Island	Y	Y	A	I	5-20	I
Little St. George Island	Y	Y	A	I	5-20	I
St. George Island - West end	N	N	C	I	>20	N
St. George Island - Developed	Y	Y	A	C	5-20	C
St. George State Park	Y	Y	I	C	5-20	C
St. George Island SP	Y	Y	A	C	5-20	C
Dog Island	Y	Y	I	C	5-20	C
Dog Island	Y	Y	A	I	<5	C
Lanark Reef	Y	N	A	I	<5	C
Lanark Reef	Y	N	A	I	<5	C
Phipps Preserve	Y	Y	A	A	<5	C
Alligator Point - Phipps Preserve	Y	Y	A	A	<5	C
Bald Point	N	N	C	A	>20	N
Alligator Point - Developed	N	N	C	A	>20	N

Table 2. Continued.

Region, Geographic Area, and Site	Potential Wintering Habitat?	Potential Breeding Habitat?	Extent of Development	Extent of Dune System	Disturbance Frequency	Extent of Habitat*
Northwest Florida continued						
Bald Point SP	Y	N	A	I	5-20	C
Bald Point - Developed	N	N	C	A	>20	N
Big Bend						
<i>Shired Island</i>						
Shired Island	Y	N	A	I	<5	I
Cedar Key						
Cedar Key - Tidal mud flats	N	N	I	A	<5	N
Shell Mound						
Shell Mound - North of Cedar Key	Y	N	A	A	<5	I
Southwest Florida						
<i>North Ancloste Bar to south end of North Clearwater Beach</i>						
North Ancloste Bar	Y	Y	A	I	<5	C
Ancloste Key SP North	Y	Y	A	I	5-20	C
Ancloste Key SP South	Y	Y	A	C	5-20	C
Three Rooker Bar	Y	Y	A	I	>20	C
Honeymoon Island SRA North	Y	Y	A	I	>20	I
Honeymoon Island SRA South	Y	Y	I	I	>20	I
Caledesi State Park/Dunedin Pass	Y	Y	C	A	>20	C
North Clearwater Beach	Y	Y	I	I	>20	I
<i>Clearwater Beach to south end of Pass-a-Grille Beach</i>						
Clearwater Beach	N	N	C	I	>20	N
Pinellas Municipal Beaches	N	N	I	I	>20	N
<i>Northwest end of Shell Key to south end of Passage Key</i>						
Shell Key	Y	Y	I	C	>20	I
Fort DeSoto North	Y	N	A	I	>20	C
Fort DeSoto West	N	Y	A	I	>20	N

Table 2. Continued.

Region, Geographic Area, and Site	Potential		Potential Breeding Habitat?	Extent of Development	Extent of Dune System	Disturbance Frequency	Extent of Habitat*
	Wintering Habitat?						
Southwest Florida continued							
Fort DesSoto South	Y		Y	I	I	>20	C
Egmont Key	Y		Y	I	I	<5	I
Sunshine Skyway Bridge	N		N	C	A	>20	N
<i>North end of Anna Maria Island to south end of Siesta Beach</i>							
Anna Maria Island	Y		Y	I	I	>20	I
Longboat Key North	Y		Y	C	I	>20	I
Longboat Key South	Y		Y	C	I	>20	I
North Lido Beach	Y		Y	I	I	>20	C
South Lido Beach	Y		Y	I	I	>20	I
<i>South Siesta Key to south end of Manasota Key</i>							
Siesta Key	Y		Y	C	I	>20	I
Turtle Beach	Y		N	C	A	>20	I
Casey Key	Y		N	C	A	>20	I
Manasota Key	Y		N	I	I	>20	I
<i>Stump Pass State Park to Gasparilla North</i>							
Charlotte Beach SRA	Y		Y	A	I	>20	I
Don Pedro Island	Y		Y	I	C	>20	I
Little Gasparilla Island	Y		Y	I	I	>20	I
Gasparilla North	Y		Y	I	I	>20	I
<i>Gasparilla South</i>							
Gasparilla South	Y		N	I	I	>20	I
<i>Cayo Costa to south end of North Captiva Island</i>							
Cayo Costa	Y		Y	A	I	>20	I
North Captiva Island	Y		Y	I	I	>20	C
<i>Captiva Island</i>							
Captiva Island	Y		Y	I	C	>20	C
<i>Sanibel Island to Big Hickory Island</i>							
Sanibel Island West	Y		Y	I	C	>20	I
Sanibel Island Central	Y		Y	I	A	>20	I
Sanibel Island East	Y		Y	C	I	>20	C

Table 2. Continued.

Region, Geographic Area, and Site	Potential		Potential Breeding Habitat?	Extent of Development	Extent of Dune System	Disturbance Frequency	Extent of Habitat*
	Wintering Habitat?						
Southwest Florida continued							
Fort Myers Beach	Y		Y	C	I	>20	C
Little Estero Island	Y		N	A	I	>20	I
Lovers Key North	Y		Y	C	I	>20	C
Lovers Key South	Y		N	C	I	>20	I
Big Hickory Island	Y		N	A	I	>20	C
Bonita Beach to Naples							
Bonita Beach	Y		N	C	A	>20	I
Barefoot Beach	N		Y	C	A	>20	N
Keywadin Island to Cape Romano							
Keywadin Island	Y		Y	A	I	<5	C
Big Marco Pass CWA	Y		Y	A	I	<5	C
Caxambas Sandbar	N		Y	A	A	<5	C
Cape Romano Large Sandbar	N		Y	A	A	5-20	C
Cape Romano Small Sandbar	N		N	A	A	<5	N
Sea Oat Island	N		Y	A	A	<5	C
Northeast Florida							
Little Talbot							
Little Talbot Island SP	Y		N	A	I	<5	C

* N = None, I = Intermittent, C = Continuous

^ C = Continuous, I = Intermittent, A = Absent

Table 3. Average number of snowy plovers at 111 sites surveyed in Florida, 15 January 2002 through 17 March 2002, and sum of site means by region.

Region, Geographic Area, and Site	Mean	SD	CV	Range	N*	Site Size (km)	Density** (# plovers/km)
Northwest Florida							
<i>Perdido Key West</i>							
Alabama Beach - Developed	0.0	n.a.	n.a.	n.a.	1	3.8	0.00
Perdido Key SRA	0.0	n.a.	n.a.	n.a.	2	2.6	0.00
Johnson Beach - Developed	0.0	n.a.	n.a.	n.a.	1	3.3	0.00
<i>Perdido Key East</i>							
GINs - Perdido Key	17.3	6.8	0.4	12-25	3	10.6	1.64
<i>Big Lagoon</i>							
Big Lagoon SRA	0.0	n.a.	n.a.	n.a.	3	2.2	0.00
<i>Fort Pickens</i>							
GINs - Fort Pickens	9.0	3.0	0.3	6-12	3	11.0	0.82
<i>Pensacola Beach</i>							
Pensacola Beach	0.0	n.a.	n.a.	n.a.	1	9.8	0.00
Santa Rosa Parking Areas	0.7	1.2	1.7	0-2	3	2.8	0.24
<i>Santa Rosa</i>							
UWF Property - Santa Rosa Island	3.3	3.5	1.1	0-7	3	2.0	1.67
GINs - Santa Rosa	11.7	8.4	0.7	2-17	3	11.1	1.05
Big Sabine Point	0.0	n.a.	n.a.	n.a.	2	^	0.00
<i>Navarre Beach</i>							
Santa Rosa Island - Developed	0.0	n.a.	n.a.	n.a.	1	5.4	0.00
Navarre Beach SP	0.0	n.a.	n.a.	n.a.	3	1.4	0.00
<i>Eglin West</i>							
Eglin AFB - West	0.0	n.a.	n.a.	n.a.	3	20.8	0.00
<i>East end of Eglin West to Beasley Park</i>							
Gulfarium and Condos	0.0	n.a.	n.a.	n.a.	1	4.8	0.00
<i>Eglin East</i>							
Eglin AFB - East	1.7	1.5	0.9	0-3	3	5.6	0.30
<i>East Pass</i>							
East Pass	1.0	1.7	1.7	0-3	3	1.1	0.91
<i>Destin to Miramar Beach</i>							
Norriego Point	0.0	n.a.	n.a.	n.a.	2	0.6	0.00

Table 3. Continued.

Region, Geographic Area, and Site	Mean	SD	CV	Range	N*	Site Size (km)	Density (# plovers/km)
Northwest Florida continued							
West Henderson - Developed	1.0	1.7	1.7	0-3	3	5.1	0.20
Henderson Beach SRA	0.7	1.2	1.7	0-2	3	2.0	0.33
East Henderson - Developed	0.0	n.a.	n.a.	n.a.	1	2.9	0.00
Miramar Beach	0.0	n.a.	n.a.	n.a.	1	7.6	0.00
Topsail Hill							
Topsail Hill Preserve SP	1.0	1.7	1.7	0-3	3	6.1	0.16
Highway 30A Lakes							
Stallworth Lake Area	0.0	n.a.	n.a.	n.a.	1	4.6	0.00
Stallworth Lake to Big Redfish Lake	0.0	n.a.	n.a.	n.a.	1	2.8	0.00
Grayton Beach SRA	0.0	n.a.	n.a.	n.a.	3	4.5	0.00
Grayton Beach SRA to Eastern Lake	0.0	n.a.	n.a.	n.a.	2	5.0	0.00
Deer Lake SP	0.0	n.a.	n.a.	n.a.	3	3.1	0.00
Camp Creek to Walton County Line	0.0	n.a.	n.a.	n.a.	1	7.5	0.00
Philips Inlet							
Philips Inlet/Camp Helen SP	1.7	2.1	1.2	0-4	3	1.1	1.52
Panama City Beach							
Panama City Beach - Developed	0.0	n.a.	n.a.	n.a.	1	27.3	0.00
St. Andrews SP - Gulf Front	2.7	2.1	0.8	1-5	3	1.7	1.57
St. Andrews SP - Kiddie Pool	0.0	n.a.	n.a.	n.a.	1	1.5	0.00
St. Andrews SP - Grand Lagoon	0.0	n.a.	n.a.	n.a.	1	1.0	0.00
Shell Island West & East							
Shell Island	8.3	8.5	1.0	2-18	3	12.3	0.68
Crooked Island West							
Tyndall AFB - Crooked Island West	6.0	0.0	0.0	0	3	10.0	0.60
Crooked Island East							
Tyndall AFB - Crooked Island East	9.7	4.0	0.4	5-12	3	9.8	0.99
Mexico Beach							
Mexico Beach - Developed	0.0	n.a.	n.a.	n.a.	2	9.3	0.00
Palm Point							
Palm Point	9.0	7.0	0.8	4-17	3	5.0	1.80

Table 3. Continued.

Region, Geographic Area, and Site	Mean	SD	CV	Range	N*	Site Size (km)	Density (# plovers/km)
Northwest Florida continued							
Windmark Beach	0.0	n.a.	n.a.	n.a.	3	1.2	0.00
<i>St. Joe Bay</i>							
Port St. Joe Beach	0.0	n.a.	n.a.	n.a.	1	^	0.00
<i>St. Joe Peninsula</i>							
St. Joe Peninsula - Developed	0.0	n.a.	n.a.	n.a.	2	9.6	0.00
<i>St. Joseph State Park</i>							
St. Joseph SP	29.7	12.3	0.4	16-40	3	13.2	2.25
<i>Cape San Blas</i>							
Cape San Blas	1.3	1.2	0.9	0-2	3	4.5	0.30
Indian Pass	0.0	n.a.	n.a.	n.a.	2	8.3	0.00
<i>Mainland shoreline from St. Vincent to Alligator Point</i>							
Yent Bayou	0.0	n.a.	n.a.	n.a.	3	3.1	0.00
Carrabelle Beach	2.3	1.5	0.7	1-4	3	0.5	4.67
Turkey Point	0.0	n.a.	n.a.	n.a.	3	0.9	0.00
<i>St. Vincent NWR</i>							
St. Vincent NWR	1.3	2.3	1.7	0-4	3	12.9	0.10
<i>Little St. George Island</i>							
Little St. George Island	6.0	4.2	0.7	3-9	2	14.9	0.40
<i>St. George Island - West end</i>							
St. George Island - Developed	0.0	n.a.	n.a.	n.a.	1	17.3	0.00
<i>St. George State Park</i>							
St. George Island SP	19.3	11.0	0.6	7-28	3	13.4	1.44
<i>Dog Island</i>							
Dog Island	13.3	8.7	0.7	6-23	3	10.9	1.22
<i>Lanark Reef</i>							
Lanark Reef	3.3	5.8	1.7	0-10	3	9.7	0.34
<i>Phipps Preserve</i>							
Alligator Point - Phipps Preserve	0.7	1.2	1.7	0-2	3	1.6	0.42
<i>Bald Point</i>							
Alligator Point - Developed	0.0	n.a.	n.a.	n.a.	1	4.9	0.00

Table 3. Continued.

Region, Geographic Area, and Site	Mean	SD	CV	Range	N*	Site Size (km)	Density (# plovers/km)
Northwest Florida continued							
Bald Point SP	0.0	n.a.	n.a.	n.a.	3	0.6	0.00
Bald Point - Developed	0.0	n.a.	n.a.	n.a.	1	5.6	0.00
Sum of Site Means, Site Size, and Mean Density	162.0				132	362.2	0.73
Big Bend							
<i>Shired Island</i>							
Shired Island	0.0	n.a.	n.a.	n.a.	2	^	0.00
<i>Cedar Key</i>							
Cedar Key - tidal mud flats	0.0	n.a.	n.a.	n.a.	1	^	0.00
<i>Shell Mound</i>							
Shell Mound - north of Cedar Key	0.0	n.a.	n.a.	n.a.	2	^	0.00
Sum of Site Means, Site Size, and Mean Density	0.0				5	^	0.00
Southwest Florida							
<i>North Anclote Bar to south end of North Clearwater Beach</i>							
North Anclote Bar	25.0	1.4	0.1	24-26	2	1.2	20.83
Anclote Key SP North	0.7	0.6	0.9	0-1	3	4.7	0.14
Anclote Key SP South	7.3	3.5	0.5	4-7	3	0.9	8.15
Three Rooker Bar	17.7	9.2	0.5	7-23	3	2.5	7.07
Honeymoon Island SRA North	3.3	3.5	1.1	0-7	3	0.6	5.56
Honeymoon Island SRA South	0.0	n.a.	n.a.	n.a.	3	4.4	0.00
Caledesi State Park/Dunedin Pass	11.7	5.0	0.4	7-17	3	3.5	3.33
North Clearwater Beach	0.0	n.a.	n.a.	n.a.	3	2.4	0.00
<i>Clearwater Beach to south end of Pass-a-Grille Beach</i>							
Clearwater Beach	0.0	n.a.	n.a.	n.a.	3	3.1	0.00
Pinellas Municipal Beaches	0.0	n.a.	n.a.	n.a.	3	32.5 [#]	0.00
<i>Northwest end of Shell Key to south end of Passage Key</i>							
Shell Key	3.0	3.0	1.0	0-6	3	2.9	1.03
Fort DeSoto North	2.0	2.0	1.0		3	2.1	0.95
Fort DeSoto West	0.7	1.2	1.7	0-4	3	1.9	0.35

Table 3. Continued.

Region, Geographic Area, and Site	Mean	SD	CV	Range	N*	Site Size (km)	Density (# plovers/km)
Southwest Florida continued							
Fort DesSoto South	0.0	n.a.	n.a.	n.a.	3	4.0	0.00
Egmont Key	0.0	n.a.	n.a.	n.a.	3	2.9	0.00
Sunshine Skyway Bridge	0.0	n.a.	n.a.	n.a.	1	15.3	0.00
<i>North end of Anna Maria Island to south end of Siesta Beach</i>							
Anna Maria Island	1.7	2.9	1.7	0-5	3	11.8	0.14
Longboat Key North	0.7	0.6	0.9	0-1	3	7.7	0.09
Longboat Key South	0.7	1.2	1.7	0-2	3	8.6	0.08
North Lido Beach	3.7	3.5	1.0	0-7	3	1.0	3.67
South Lido Beach	0.0	n.a.	n.a.	n.a.	3	2.9	0.00
<i>South Siesta Key to south end of Manasota Key</i>							
Siesta Key	2.3	0.6	0.2	2-3	3	4.5	0.52
Turtle Beach	0.0	n.a.	n.a.	n.a.	3	6.1	0.00
Casey Key	0.0	n.a.	n.a.	n.a.	3	8.8	0.00
Manasota Key	0.0	n.a.	n.a.	n.a.	3	23.3	0.00
<i>Stump Pass State Park to Gasparilla North</i>							
Charlotte Beach SRA	4.3	4.0	0.9	2-9	3	2.7	1.60
Don Pedro Island	1.7	2.9	1.7	0-5	3	7.2	0.23
Little Gasparilla Island	0.0	n.a.	n.a.	n.a.	2	3.3	0.00
Gasparilla North	2.5	1.7	0.7	0-4	4	5.9	0.42
<i>Gasparilla South</i>							
Gasparilla South	0.0	n.a.	n.a.	n.a.	3	1.9	0.00
<i>Cayo Costa to south end of North Captiva Island</i>							
Cayo Costa	11.5	5.1	0.4	4-15	4	10.7	1.07
North Captiva Island	0.0	n.a.	n.a.	n.a.	3	4.2	0.00
<i>Captiva Island</i>							
Captiva Island	0.0	n.a.	n.a.	n.a.	4	7.8	0.00
<i>Sanibel Island to Big Hickory Island</i>							
Sanibel Island West	0.0	n.a.	n.a.	n.a.	3	1.9	0.00
Sanibel Island Central	3.7	5.5	1.5	0-10	3	9.7	0.38
Sanibel Island East	1.3	2.3	1.7	0-4	3	7.5	0.18

Table 3. Continued.

Region, Geographic Area, and Site	Mean	SD	CV	Range	N*	Site Size (km)	Density (# plovers/km)
Southwest Florida continued							
Fort Myers Beach	1.3	2.5	2.0	0-5	4	8.3	0.15
Little Estero Island	0.0	n.a.	n.a.	n.a.	4	2.5	0.00
Lovers Key North	2.5	2.9	1.2	0-5	4	1.8	1.39
Lovers Key South	0.0	n.a.	n.a.	n.a.	3	1.1	0.00
Big Hickory Island	3.4	6.1	1.8	0-14	5	1.4	2.43
<i>Bonita Beach to Naples</i>							
Bonita Beach	0.0	n.a.	n.a.	n.a.	4	4.1	0.00
Barefoot Beach	0.0	n.a.	n.a.	n.a.	1	4.6	0.00
<i>Keywadin Island to Cape Romano</i>							
Keywadin Island	4.0	1.4	0.4	3-5	2	1.7	2.35
Big Marco Pass CWA	9.7	7.1	0.7	2-16	3	1.7	5.71
Caxambas Sandbar	0.0	n.a.	n.a.	n.a.	1	7.4	0.00
Cape Romano Large Sandbar	0.0	n.a.	n.a.	n.a.	1	1.1	0.00
Cape Romano Small Sandbar	0.0	n.a.	n.a.	n.a.	1	^	0.00
Sea Oat Island	0.0	n.a.	n.a.	n.a.	1	^	0.00
Sum of Site Means, Site Size, and Mean Density	126.2				141	225.6	1.61
Northeast Florida							
<i>Little Talbot</i>							
Little Talbot Island SP	0.5	0.7	1.4	0-1	2	2.9	0.17
Sum of Site Means, Site Size, and Mean Density	0.5				2	2.9	0.17
STATEWIDE SUM OF SITE MEANS, SITE SIZE, and MEAN DENSITY							
	288.7				280	590.7	1.20

* Number of site visits

** Geographic areas comprised of only sites without plovers are not included in the mean density calculation.

^ Site was too small to have meaningful linear distance calculated.

Distance from the northernmost public beach to the southernmost public beach. Only the public beaches, not the areas in between, were surveyed.

n.a. = non-applicable

Table 4. Total number of wintering snowy plovers observed per site per survey period, 15 January 2002 to 17 March 2002.

Region, Geographic Area, and Site	Survey Period 1 1/15/02 to 2/6/02	Survey Period 2 2/7/02 to 2/25/02	Survey Period 3 2/25/02 to 3/17/02
Northwest Florida			
<i>Perdido Key West</i>			
Alabama Beach - Developed	*	0	^
Perdido Key SRA	*	0	0
Johnson Beach - Developed	*	0	^
<i>Perdido Key East</i>			
GINS - Perdido Key	12	25	15
<i>Big Lagoon</i>			
Big Lagoon SRA	0	0	0
<i>Fort Pickens</i>			
GINS - Fort Pickens	6	9	12
<i>Pensacola Beach</i>			
Pensacola Beach	*	0	^
Santa Rosa Parking Areas	0	0	2
<i>Santa Rosa</i>			
UWF Property - Santa Rosa Island	3	7	0
GINS - Santa Rosa	16	2	17
Big Sabine Point	*	0	0
<i>Navarre Beach</i>			
Santa Rosa Island - Developed	*	0	^
Navarre Beach SP	0	0	0
<i>Eglin West</i>			
Eglin AFB - West	0	0	0
<i>East end of Eglin West to Beasley Park</i>			
Gulfarium and Condos	*	0	^
<i>Eglin East</i>			
Eglin AFB - East	2	0	3
<i>East Pass</i>			
East Pass	0	0	3
<i>Destin to Miramar Beach</i>			
Norriego Point	*	0	0

Table 4. Continued.

Region, Geographic Area, and Site	Survey Period 1 1/15/02 to 2/6/02	Survey Period 2 2/7/02 to 2/25/02	Survey Period 3 2/25/02 to 3/17/02
Northwest Florida continued			
West Henderson - Developed	3	0	0
Henderson Beach SRA	0	0	2
East Henderson - Developed	0	^	^
Miramar Beach	*	0	^
Topsail Hill			
Topsail Hill Preserve SP	3	0	0
Highway 30A Lakes			
Stallworth Lake Area	0	^	^
Stallworth Lake to Big Redfish Lake	0	^	^
Grayton Beach SRA	0	0	0
Grayton Beach SRA to Eastern Lake	0	0	^
Deer Lake SP	0	0	0
Camp Creek to Walton County Line	*	0	^
Philips Inlet			
Philips Inlet/Camp Helen SP	1	0	4
Panama City Beach			
Panama City Beach - Developed	0	^	^
St. Andrews SP - Gulf Front	2	5	1
St. Andrews SP - Kiddie Pool	0	^	^
St. Andrews SP - Grand Lagoon	0	^	^
Shell Island West & East			
Shell Island	2	5	18
Crooked Island West			
Tyndall AFB - Crooked Island West	6	6	6
Crooked Island East			
Tyndall AFB - Crooked Island East	5	12	12
Mexico Beach			
Mexico Beach - Developed	0	0	^
Palm Point			
Palm Point	17	4	6

Table 4. Continued.

Region, Geographic Area, and Site	Survey Period 1 1/15/02 to 2/6/02	Survey Period 2 2/7/02 to 2/23/02	Survey Period 3 2/24/02 to 3/14/02
Northwest Florida continued			
Windmark Beach	0	0	0
<i>St. Joe Bay</i>			
Port St. Joe Beach	0	^	^
<i>St. Joe Peninsula</i>			
St. Joe Peninsula - Developed	0	0	^
<i>St. Joseph State Park</i>			
St. Joseph SP	33	40	16
<i>Cape San Blas</i>			
Cape San Blas	2	2	0
Indian Pass	0	*	0
<i>Mainland Shoreline from St. Vincent to Alligator Point</i>			
Yent Bayou	0	0	0
Carrabelle Beach	4	2	1
Turkey Point	0	0	0
<i>St. Vincent NWR</i>			
St. Vincent NWR	0	0	4
<i>Little St. George Island</i>			
Little St. George Island	*	3	9
<i>St. George Island - West end</i>			
St. George Island - Developed	0	^	^
<i>St. George State Park</i>			
St. George Island SP	7	23	28
<i>Dog Island</i>			
Dog Island	6	11	23
<i>Lanark Reef</i>			
Lanark Reef	10	0	0
<i>Phipps Preserve</i>			
Alligator Point - Phipps Preserve	0	0	2
<i>Bald Point</i>			
Alligator Point - Developed	0	^	^

Table 4. Continued.

Region, Geographic Area, and Site	Survey Period 1 1/15/02 to 2/6/02	Survey Period 2 2/7/02 to 2/23/02	Survey Period 3 2/24/02 to 3/14/02
Northwest Florida continued			
Bald Point SP	0	0	0
Bald Point - Developed	0	^	^
Region Total	140	156	184
Big Bend			
<i>Shired Island</i>			
Shired Island	*	0	0
<i>Cedar Key</i>			
Cedar Key - Tidal mud flats	*	0	^
<i>Shell Mound</i>			
Shell Mound - North of Cedar Key	*	0	0
Region Total	*	0	0
Southwest Florida			
<i>North Anclote Bar to south end of North Clearwater Beach</i>			
North Anclote Bar	24	*	26
Anclote Key SP North	0	1	1
Anclote Key SP South	11	4	7
Three Rooker Bar	23	23	7
Honeymoon Island SRA North	0	7	3
Honeymoon Island SRA South	0	0	0
Caledesi State Park/Dunedin Pass	17	11	7
North Clearwater Beach	0	0	0
<i>Clearwater Beach to south end of Pass-a-Grille Beach</i>			
Clearwater Beach	0	0	0
Pinellas Municipal Beaches	0	0	0
<i>Northwest end of Shell Key to south end of Passage Key</i>			
Shell Key	6	3	0
Fort DeSoto North	0	2	4
Fort DeSoto West	0	0	2

Table 4. Continued.

Region, Geographic Area, and Site	Survey Period 1 1/15/02 to 2/6/02	Survey Period 2 2/7/02 to 2/23/02	Survey Period 3 2/24/02 to 3/14/02
Southwest Florida continued			
Fort DesSoto South	0	0	0
Egmont Key	0	0	0
Sunshine Skyway Bridge	0	^	^
<i>North end of Anna Maria Island to south end of Siesta Beach</i>			
Anna Maria Island	0	5	0
Longboat Key North	0	1	1
Longboat Key South	2	0	0
North Lido Beach	0	7	4
South Lido Beach	0	0	0
<i>South Siesta Key to south end of Manasota Key</i>			
Siesta Key	2	3	2
Turtle Beach	0	0	0
Casey Key	0	0	0
Manasota Key	0	0	0
<i>Stump Pass State Park to Gasparilla North</i>			
Charlotte Beach SRA	2	9	2
Don Pedro Island	0	5	0
Little Gasparilla Island	*	0	0
Gasparilla North	3	0	4
<i>Gasparilla South</i>			
Gasparilla South	0	0	0
<i>Cayo Costa to south end of North Captiva Island</i>			
Cayo Costa	15	14	13
North Captiva Island	0	0	0
<i>Captiva Island</i>			
Captiva Island	0	0	0
<i>Sanibel Island to Big Hickory Island</i>			
Sanibel Island West	0	0	0
Sanibel Island Central	0	10	1
Sanibel Island East	0	0	4

Table 4. Continued.

Region, Geographic Area, and Site	Survey Period 1 1/15/02 to 2/6/02	Survey Period 2 2/7/02 to 2/23/02	Survey Period 3 2/24/02 to 3/14/02
Southwest Florida continued			
Fort Myers Beach	0	5	0
Little Estero Island	0	0	0
Lovers Key North	0	5	5
Lovers Key South	0	0	0
Big Hickory Island	3	14	0
<i>Bonita Beach to Naples</i>			
Bonita Beach	0	0	0
Barefoot Beach	*	*	0
<i>Keywadin Island to Cape Romano</i>			
Keywadin Island	3	*	5
Big Marco Pass CWA	2	16	11
Caxambas Sandbar	0	^	^
Cape Romano Large Sandbar	*	*	0
Cape Romano Small Sandbar	*	*	0
Sea Oat Island	0	^	^
Region Total	113	145	100
Northeast Florida			
<i>Little Talbot</i>			
Little Talbot Island SP	1	0	*
Region Total	1	0	*
STATEWIDE TOTAL	254	301	284

* Not Surveyed

^ Not Suitable Habitat - dropped from survey

Table 5. Sites utilized by snowy plovers and either piping plovers, Wilson's plovers, or American oystercatchers, 15 January 2002 through 17 March 2002.

Region, Site	Piping Plover	Wilson's Plover	American Oystercatcher
Northwest Florida			
GINS - Santa Rosa	X		
Shell Island		X	
Tyndall AFB - Crooked Island East	X	X	X
St. Joseph SP	X		
Cape San Blas	X		
Carrabelle Beach		X	
Little St. George Island		X	X
St. George Island SP	X		X
Dog Island	X	X	X
Lanark Reef	X	X	X
Alligator Point - Phipps Preserve	X		X
Southwest Florida			
North Anclote Bar	X	X	
Anclote Key SP North			X
Anclote Key SP South	X	X	X
Three Rooker Bar	X	X	X
Honeymoon Island SRA North	X	X	X
Caledesi State Park/Dunedin Pass	X	X	X
Fort DeSoto North	X		X
Fort DeSoto West			X
Shell Key	X	X	X
Anna Maria Island			X
Charlotte Beach SRA	X	X	
Don Pedro Island		X	
Cayo Costa		X	
Lovers Key North		X	
Big Hickory Island	X	X	
Big Marco Pass CWA	X	X	X
Northeast Florida			
Little Talbot Island SP	X	X	

Table 6. Highest number of possible snowy plover breeding pairs per site per survey period, 17 February 2002 to 4 August 2002.

Region, Geographic Area, and Site	Wintering Survey Periods [#]		Breeding		Survey	Periods		Highest # of Possible Breeding Pairs
	2-3		1-2	3-4	5-6	7-8	9-10	
	2/17/02 to 3/17/02		3/18/02 to 4/14/02	4/15/02 to 5/12/02	5/13/02 to 6/9/02	6/10/02 to 7/7/02	7/8/02 to 8/4/02	
Northwest Florida								
Perdido Key West								
Alabama Beach - Developed	0		^	^	^	^	^	0
Perdido Key SRA	0		0	0	0	0	0	0
Johnson Beach - Developed	0		^	^	^	^	^	0
Perdido Key East								
GINS - Perdido Key	0		8	8	6	7	6	8
Big Lagoon								
Big Lagoon SRA	0		^	^	^	^	^	0
Fort Pickens								
GINS - Fort Pickens	0		5	8	6	6	3	8
Pensacola Beach								
Pensacola Beach	0		^	^	^	^	^	0
Santa Rosa Parking Areas	0		0	0	0	0	0	0
Santa Rosa								
UWF Property - Santa Rosa Island	0		1	0	0	0	0	1
GINS - Santa Rosa	0		4	5	6	4	1	6
Big Sabine Point	0		^	^	^	^	^	0
Navarre Beach								
Santa Rosa Island - Developed	0		^	^	^	^	^	0
Navarre Beach SP	0		0	0	2	1	0	2
Eglin West								
Eglin AFB - West	0		0	5	9	8	10	10
East end of Eglin West to Beasley Park								
Gulfarium and Condos	0		^	^	^	^	^	0
Eglin East								
Eglin AFB - East	0		0	1	1	2	0	2
East Pass								
East Pass	0		0	1	3	1	2	3
Destin to Miramar Beach								
Norriego Point	0		0	0	0	0	0	0

Table 6. Continued.

Region, Geographic Area, and Site	Wintering Survey Periods [#]		Breeding		Survey		Periods		Highest # of Possible Breeding Pairs				
	2-3		1-2		3-4		5-6			7-8		9-10	
	2/17/02 to 3/17/02		3/18/02 to 4/14/02		4/15/02 to 5/12/02		5/13/02 to 6/9/02			6/10/02 to 7/7/02		7/8/02 to 8/4/02	
Northwest Florida continued													
West Henderson - Developed	0		^		^		^		^		^	0	
Henderson Beach SRA	0		0		0		0		0		0	0	
East Henderson - Developed	0		^		^		^		^		^	0	
Miramar Beach	0		^		^		^		^		^	0	
Topsail Hill													
Topsail Hill Preserve SP	0		2		3		1		0		1	3	
Highway 30A Lakes													
Stallworth Lake Area	0		^		^		^		^		^	0	
Stallworth Lake to Big Redfish Lake	0		^		^		^		^		^	0	
Grayton Beach SRA	0		0		0		0		0		0	0	
Grayton Beach SRA to Eastern Lake	0		^		^		^		^		^	0	
Deer Lake SP	0		0		0		2		1		0	2	
Camp Creek to Walton County Line	0		0		0		0		0		0	0	
Philips Inlet													
Philips Inlet/Camp Helen SP	0		0		1		0		2		3	3	
Panama City Beach													
Panama City Beach - Developed	0		^		^		^		^		^	0	
St. Andrews SP - Gulf Front	0		0		0		0		0		0	0	
St. Andrews SP - Kiddie Pool	0		^		^		^		^		^	0	
St. Andrews SP - Grand Lagoon	0		^		^		^		^		^	0	
Shell Island West & East													
Shell Island	0		7		6		11		3		3	11	
Crooked Island West													
Tyndall AFB - Crooked Island West	0		6		12		9		11		7	12	
Crooked Island East													
Tyndall AFB - Crooked Island East	0		8		12		13		12		6	13	
Mexico Beach													
Mexico Beach - Developed	0		^		^		^		^		^	0	
Palm Point													
Palm Point	0		5		6		5		4		0	6	

Table 6. Continued.

Region, Geographic Area, and Site	Wintering Survey Periods [#]		Breeding		Survey	Periods		Highest # of Possible Breeding Pairs
	2-3		1-2	3-4	5-6	7-8	9-10	
	2/17/02 to 3/17/02		3/18/02 to 4/14/02	4/15/02 to 5/12/02	5/13/02 to 6/9/02	6/10/02 to 7/7/02	7/8/02 to 8/4/02	
Northwest Florida continued								
Windmark Beach	0		^		^		^	0
St. Joe Bay								
Port St. Joe Beach	0		^		^		^	0
St. Joe Peninsula								
St. Joe Peninsula - Developed	0		^		^		^	0
St. Joseph State Park								
St. Joseph SP	0		15	23	22	21	8	23
Cape San Blas								
Cape San Blas	0		2	2	0	0	0	2
Indian Pass	0		^	^	^	^	^	0
Mainland Shoreline from St. Vincent to Alligator Point								
Yent Bayou	0		^	^	^	^	^	0
Carrabelle Beach	0		^	^	^	^	^	0
Turkey Point	0		*	*	*	*	*	0
St. Vincent NWR								
St. Vincent NWR	1		1	2	3	3	1	3
Little St. George Island								
Little St. George Island	0		4	8	3	2	2	8
St. George Island - West end								
St. George Island - Developed	0		^	^	^	^	^	0
St. George State Park								
St. George Island SP	0		11	16	10	4	4	16
Dog Island								
Dog Island	7		11	6	2	0	0	11
Lanark Reef								
Lanark Reef	0		^	^	^	^	^	0
Phipps Preserve								
Alligator Point - Phipps Preserve	0		0	0	0	0	*	0
Bald Point								
Alligator Point - Developed	0		^	^	^	^	^	0

Table 6. Continued.

Region, Geographic Area, and Site	Wintering Survey Periods [#]			Breeding 3-4 4/15/02 to 5/12/02	Survey 5-6 5/13/02 to 6/9/02	Periods		Highest # of Possible Breeding Pairs
	2-3 2/17/02 to 3/17/02	1-2 3/18/02 to 4/14/02				7-8 6/10/02 to 7/7/02	9-10 7/8/02 to 8/4/02	
Northwest Florida continued								
Bald Point SP	0	^	^	^	^	^	^	0
Bald Point - Developed	0	^	^	^	^	^	^	0
Region Total	8	90	125	114	92	57	153	
Big Bend								
Shired Island								
Shired Island	0	^	^	^	^	^	^	0
Cedar Key								
Cedar Key - Tidal mud flats	0	^	^	^	^	^	^	0
Shell Mound								
Shell Mound - North of Cedar Key	0	^	^	^	^	^	^	0
Region Total	0	^	^	^	^	^	^	0
Southwest Florida								
North Anclote Bar to south end of North Clearwater Beach								
North Anclote Bar	0	0	1	0	2	0	0	2
Anclote Key SP North	0	0	0	0	2	0	0	2
Anclote Key SP South	0	0	0	0	0	0	0	0
Three Rooker Bar	0	1	1	0	0	0	0	1
Honeymoon Island SRA North	1	0	0	1	1	0	0	1
Honeymoon Island SRA South	0	0	1	0	1	0	0	1
Caledesi State Park/Dunedin Pass	0	4	2	1	3	2	2	4
North Clearwater Beach	0	0	1	1	2	1	1	2
Clearwater Beach to south end of Pass-a-Grille Beach								
Clearwater Beach	0	^	^	^	^	^	^	0
Pinellas Municipal Beaches	0	^	^	^	^	^	^	0
Northwest end of Shell Key to south end of Passage Key								
Shell Key	0	1	0	0	0	0	0	1
Fort DesSoto South	0	0	^	^	^	^	^	0
Egmont Key	0	0	0	^	^	^	^	0

Table 6. Continued.

Region, Geographic Area, and Site	Wintering Survey Periods [#]		Breeding		Survey	Periods		Highest # of Possible Breeding Pairs
	2-3		1-2	3-4	5-6	7-8	9-10	
	2/17/02 to 3/17/02	3/18/02 to 4/14/02						
Southwest Florida continued								
Sunshine Skyway Bridge	0		^		^	^	^	0
North end of Anna Maria Island to south end of Siesta Beach								
Anna Maria Island	0	0		0	^	^	^	0
Longboat Key North	0	1		0	*	*	*	1
Longboat Key South	0	0		^	^	^	^	0
North Lido Beach	0	0		2	2	2	2	2
South Lido Beach	0	0		0	^	^	^	0
South Siesta Key to south end of Manasota Key								
Siesta Key	0	1		0	0	0	*	1
Turtle Beach	0	^		^	^	^	^	0
Casey Key	0	^		^	^	^	^	0
Manasota Key	0	^		^	^	^	^	0
Stump Pass State Park to Gasparilla North								
Charlotte Beach SRA	0	3		3	2	3	0	3
Don Pedro Island	0	1		3	3	1	1	3
Little Gasparilla Island	0	*		*	*	*	*	0
Gasparilla North	1	1		2	2	3	2	3
Gasparilla South								
Gasparilla South	0	^		^	^	^	^	0
Cayo Costa to south end of North Captiva Island								
Cayo Costa	1	1		2	1	2	1	2
North Captiva Island	0	0		*	*	*	*	0
Captiva Island								
Captiva Island	0	0		0	0	0	0	0
Sanibel Island to Big Hickory Island								
Sanibel Island West	0	0		0	0	0	0	0
Sanibel Island Central	0	8		13	13	9	4	13
Sanibel Island East	2	4		3	6	6	2	6
Fort Myers Beach	0	^		^	^	^	^	0
Little Estero Island	0	0		1	1	0	0	1

Table 7. Total number of snowy plover breeding pairs observed in 2002 and 1989*.

Region	Survey Year		Difference	% Change
	2002	1989		
Northwest Florida	153	145	8	5.5
Southwest Florida	60	22	38	172.7
Statewide Total, Mean Difference, and Mean % Change	213	167	46	27.5

* Data reproduced here from Gore and Chase, 1989.

Table 8. Change in number of snowy plover breeding pairs per geographic region from 1989 to 2002.

Region and Geographic Area	Survey Year		Difference	% Change
	2002	1989		
Northwest Florida				
<i>Perdido Key West</i>	0*	0	n.a.	n.a.
<i>Perdido Key East</i>	8	5	3	60.0
<i>Big Lagoon</i>	*	*	n.a.	n.a.
<i>Fort Pickens</i>	8	9	-1	-11.1
<i>Pensacola Beach</i>	0*	0	n.a.	n.a.
<i>Santa Rosa</i>	7	4	3	75.0
<i>Navarre Beach</i>	2^	0	2	n.a.
<i>Eglin West</i>	10	38	-28	-73.7
<i>East end of Eglin West to Beasley Park</i>	0*	0	n.a.	n.a.
<i>Eglin East</i>	2	6	-4	-66.7
<i>East Pass</i>	3	9	-6	-66.7
<i>Destin to Miramar Beach</i>	0*	0	n.a.	n.a.
<i>Topsail Hill</i>	3	8	-5	-62.5
<i>Highway 30A Lakes</i>	2^	8	-6	-75.0
<i>Philips Inlet</i>	3	4	-1	-25.0
<i>Panama City Beach</i>	0*	3	n.a.	n.a.
<i>Shell Island West & East</i>	11	4	7	175.0
<i>Crooked Island West & East</i>	25	5	20	400.0
<i>Mexico Beach</i>	0*	0	n.a.	n.a.
<i>Palm Point</i>	6	6	0	0.0
<i>St. Joe Bay</i>	*	1	n.a.	n.a.
<i>St. Joe Peninsula</i>	*	*	n.a.	n.a.
<i>St. Joseph State Park</i>	23	6	17	283.3
<i>Cape San Blas</i>	2	0	2	n.a.
<i>Mainland Shoreline St. Vincent to Alligator Point</i>	*	0	n.a.	n.a.
<i>St. Vincent NWR</i>	3	5	-2	-40.0
<i>Little St. George Island</i>	8	4	4	100.0
<i>St. George Island - West end</i>	*	0	n.a.	n.a.
<i>St. George State Park</i>	16	17	-1	-5.9
<i>Dog Island</i>	11	0	11	n.a.
<i>Lanark Reef</i>	*	*	n.a.	n.a.

Table 8. Continued.

Region and Geographic Area	Survey Year		Difference	% Change
	2002	1989		
Northwest Florida continued				
<i>Phipps Preserve</i>	0	3	-3	-100.0
<i>Bald Point</i>	*	0	n.a.	n.a.
Region Total, Mean Difference, and Mean % Change	153	145	8	5.5

* Area dropped from survey or not surveyed.

^ Survey limited to public lands within the geographic area.

n.a. = non-applicable

Table 9. Number and density of snowy plover breeding pairs in northwest Florida by geographic area in 2002 and 1989*.

Region and Geographic Area	2002 Number of Breeding Pairs	1989 Number of Breeding Pairs	2002 Length of Beach (km)	2002 Density (pairs/km)	1989 Density (pairs/km)
Northwest Florida					
<i>Perdido Key East</i>	8	5	10.6	0.8	0.7
<i>Fort Pickens</i>	8	9	11.0	0.7	0.8
<i>Santa Rosa</i>	7	4	13.1	0.5	0.2
<i>Navarre Beach</i>	2	0	6.8	0.3	n.a.
<i>Eglin West</i>	10	38	20.8	0.5	1.8
<i>Eglin East</i>	2	6	5.6	0.4	1.0
<i>East Pass</i>	3	9	1.1	2.7	9.0
<i>Topsail Hill</i>	3	8	6.1	0.5	1.3
<i>Highway 30A Lakes</i>	2	8	27.5	0.1	0.3
<i>Philips Inlet</i>	3	4	1.1	2.7	5.0
<i>Shell Island West & East</i>	11	4	12.3	0.9	1.7
<i>Crooked Island West & East</i>	25	5	19.8	1.3	0.2
<i>Palm Point</i>	6	6	5.0	1.2	1.9
<i>St. Joseph State Park</i>	23	6	13.2	1.7	0.4
<i>Cape San Blas</i>	2	0	12.8	0.2	n.a.
<i>St. Vincent NWR</i>	3	5	12.9	0.2	0.3
<i>Little St. George Island</i>	8	4	14.9	0.5	0.3
<i>St. George State Park</i>	16	17	13.4	1.2	1.2
<i>Dog Island</i>	11	0	10.9	1.0	n.a.
<i>Alligator Point</i>	0	3	n.a.	n.a.	1.6
additional isolated pairs	0	4	n.a.	n.a.	n.a.
Region Total and Mean Density	153	145	218.9	0.7	0.6

* Data reproduced here from Gore and Chase 1989.

n.a. = non-applicable

Table 10. Number and density of snowy plover breeding pairs in southwest Florida by site in 2002 and 1989*.

Region, Geographic Area, and Site	2002 Number of Breeding Pairs	1989 Number of Breeding Pairs	2002 Length of Beach (km)	2002 Density (pairs/km)
Southwest Florida				
<i>North Anclote Bar to south end of North Clearwater Beach</i>				
North Anclote Bar	2	^	1.2	1.7
Anclote Key SP North	2	^	4.7	0.4
Three Rooker Bar	1	3	2.5	0.4
Honeymoon Island SRA North	1	^	0.6	1.7
Honeymoon Island SRA South	1	^	4.4	0.2
Caledesi State Park/Dunedin Pass	4	1	3.5	1.1
North Clearwater Beach	2	4	2.4	0.8
Sum of Totals and Mean Density	13	8	19.3	0.7
<i>Northwest end of Shell Key to Fort DeSoto</i>				
Shell Key	1	^	2.9	0.3
Fort DeSoto North	1	3	2.1	0.5
Fort DeSoto West	2	^	1.9	1.1
Sum of Totals and Mean Density	4	3	6.9	0.6
<i>Longboat Key North to North Lido Beach</i>				
Longboat Key North	1	^	7.7	0.1
North Lido Beach	2	^	1	2.0
Sum of Totals and Mean Density	3	^	8.7	0.3
<i>South Siesta Key</i>				
Siesta Key	1	^	4.5	0.2
Sum of Totals and Mean Density	1	^	4.5	0.2
<i>Stump Pass State Park to Gasparilla North</i>				
Charlotte Beach SRA	3	^	2.7	1.1
Don Pedro Island	3	1	7.2	0.4
Gasparilla North	3	^	5.9	0.5
Sum of Totals and Mean Density	9	1	15.8	0.6

Table 10. Continued.

Region, Geographic Area, and Site	2002 Number of Breeding Pairs	1989 Number of Breeding Pairs	2002 Length of Beach (km)	2002 Density (pairs/km)
Southwest Florida continued				
Cayo Costa	2	5	10.7	0.2
Sum of Totals and Mean Density	2	5	10.7	0.2
Sanibel Island to Little Estero Island				
Sanibel Island Central	13	^	9.7	1.3
Sanibel Island East	6	^	7.5	0.8
Little Estero Island	1	^	2.5	0.4
Sum of Totals and Mean Density	20	^	19.7	1.0
Keywadin Island to Big Marco Pass CWA				
Keywadin Island	3	^	1.7	1.8
Big Marco Pass CWA	5	5	1.7	2.9
Sum of Totals and Mean Density	8	5	3.4	2.4
SUM OF REGIONAL TOTALS AND MEAN DENSITY				
	60	22	89.0	0.9

* Data reproduced here from Gore and Chase 1989. Length of beach and density of snowy plover breeding pairs were not calculated in 1989.

^ Not surveyed

Table 11. Sites utilized by snowy plovers and Wilson's plovers, 18 March 2002 to 4 August 2002.

Region, Site	Wilson's Plovers Observed	Wilson's Plovers Breeding	Wilson's Plover/Snowy Plover Interaction
Northwest Florida			
GINS - Ft. Pickens	X		
UWF - Santa Rosa	X	X	
GINS - Santa Rosa	X	X	X
Eglin - West	X		
Topsail Hill Preserve SP	X		X
Shell Island	X	X	X
Tyndall AFB - Crooked Island West	X	X	X
Tyndall AFB - Crooked Island East	X	X	X
St. Joseph Peninsula SP	X		X
Little St. George Island	X		X
St. George Island SP	X	X	X
Dog Island	X		X
Alligator Point - Phipps Preserve	X	X	X
Southwest Florida			
North Anclote Bar	X	X	X
Anclote Key SP North	X		
Anclote Key SP South	X	X	X
Three Rooker Bar	X	X	X
Honeymoon Island SRA North	X	X	X
Honeymoon Island SRA South	X		X
North Lido Beach	X		X
Caledesi State Park/Dunedin Pass	X	X	X
Fort DeSoto West	X		X
Shell Key	X		
Charlotte Beach SRA	X	X	X
Don Pedro Island	X	X	X
Gasparilla North	X	X	X
Cayo Costa	X	X	X
Sanibel Central	X	X	X
Little Estero	X	X	X
Keywadin Island	X	X	X
Big Marco Pass CWA	X	X	X

Table 12. Characteristics of 188 snowy plover nests located in Florida in 2002.

Variable Measured	Range	Mean	Number of Nests	% of Total Nests
Distance (m) to:				
High tide line	0-200	51.3		
Primary dune line	0-200	28.0		
Nearest vegetation	0-32	1.6		
Nearest debris	0-23.5	1.9		
Nearest building	0-13,080*	2894		
Nearest public access	0-9475*	2080		
Type of vegetation near nest:				
Grass			78	41
Forb			90	48
Other			19	10
None within 1m			61	33
Nest <1m from vegetation			126	67
Nest <1m from debris			108	57
Nest <1m from vegetation and debris			64	34
Nest <1m from either vegetation or debris			170	90
Nest lined with shell			163	88
Nest location				
In front of primary dune			61	33
Behind primary dune			54	29
In dune pocket opening			64	34
Other (flat - no dunes)			8	4
Nest located with water in view			148	79

* 0 m indicates that the nest was located directly seaward of the building or public access.

Table 13. Characteristics of Northwest region snowy plover nests documented in 2002 and 1989* .

Variable Measured	Range		Mean		Number of Nests		% of Total Nests	
	2002	1989	2002	1989	2002	1989	2002	1989
Distance (m) to:								
High tide line	6.4-200	0-250	59.8	61.5				
Primary dune line	1.5-200	0-60	33.7	10.5				
Nearest vegetation	0-18	0-22	0.98	1.4				
Nearest debris	0-23.5	^	2.64	^				
Nearest building	0-13,080	150-10,000						
Nearest public access	0-9475	50-10,000						
Type of vegetation near nest:								
Grass					56	35	44	41
Forb					56	26	44	31
Other					15	^	12	^
None within 1m					0	24	0	28
Nest <1m from vegetation					92	^	73	^
Nest <1m from debris					63	^	50	^
Nest <1m from vegetation and debris					44	^	35	^
Nest <1m from either vegetation or debris					111	85	87	100
Nest lined with shell					118	79	94	93
Nest location								
In front of primary dune					17	40	13	47
Behind primary dune					52	13	41	15
In dune pocket opening					57	32	45	38
Other (flat - no dunes)					0	^	0	^
Nest located with water in view					88	68	69	80

* Data reproduced here from Gore and Chase 1989.

^ Characteristic not recorded during survey year.

Table 14. Characteristics of 127 Northwest region and 61 Southwest region snowy plover nests.

Variable Measured	Range		Mean		Number of Nests		% of Total Nests	
	NW	SW	NW	SW	NW	SW	NW	SW
Distance (m) to:								
High tide line	6.4-200	2-199	59.8	33.6				
Primary dune line	1.5-200	0-67	33.7	13.6				
Nearest vegetation	0-18	0-32	0.98	3				
Nearest debris	0-23.5	0-5.6	2.64	0.3				
Nearest building	0-13,080	0-1154	4109	251				
Nearest public access	0-9475	0-1847	2739	304				
Type of vegetation near nest:								
Grass					56	22	44	36
Forb					56	34	44	56
Other					15	4	12	7
None within 1m					0	1	0	2
Nest <1m from vegetation					92	34	73	57
Nest <1m from debris					63	45	50	74
Nest <1m from vegetation and debris					44	20	35	33
Nest <1m from either vegetation or debris					111	59	87	97
Nest lined with shell					118	45	94	74
Nest location								
In front of primary dune					17	44	13	72
Behind primary dune					52	2	41	3
In dune pocket opening					57	7	45	11
Other (flat - no dunes)					0	8	0	13
Nest located with water in view					88	60	69	98

Figure 1. Northwest region geographic areas with breeding snowy plovers.

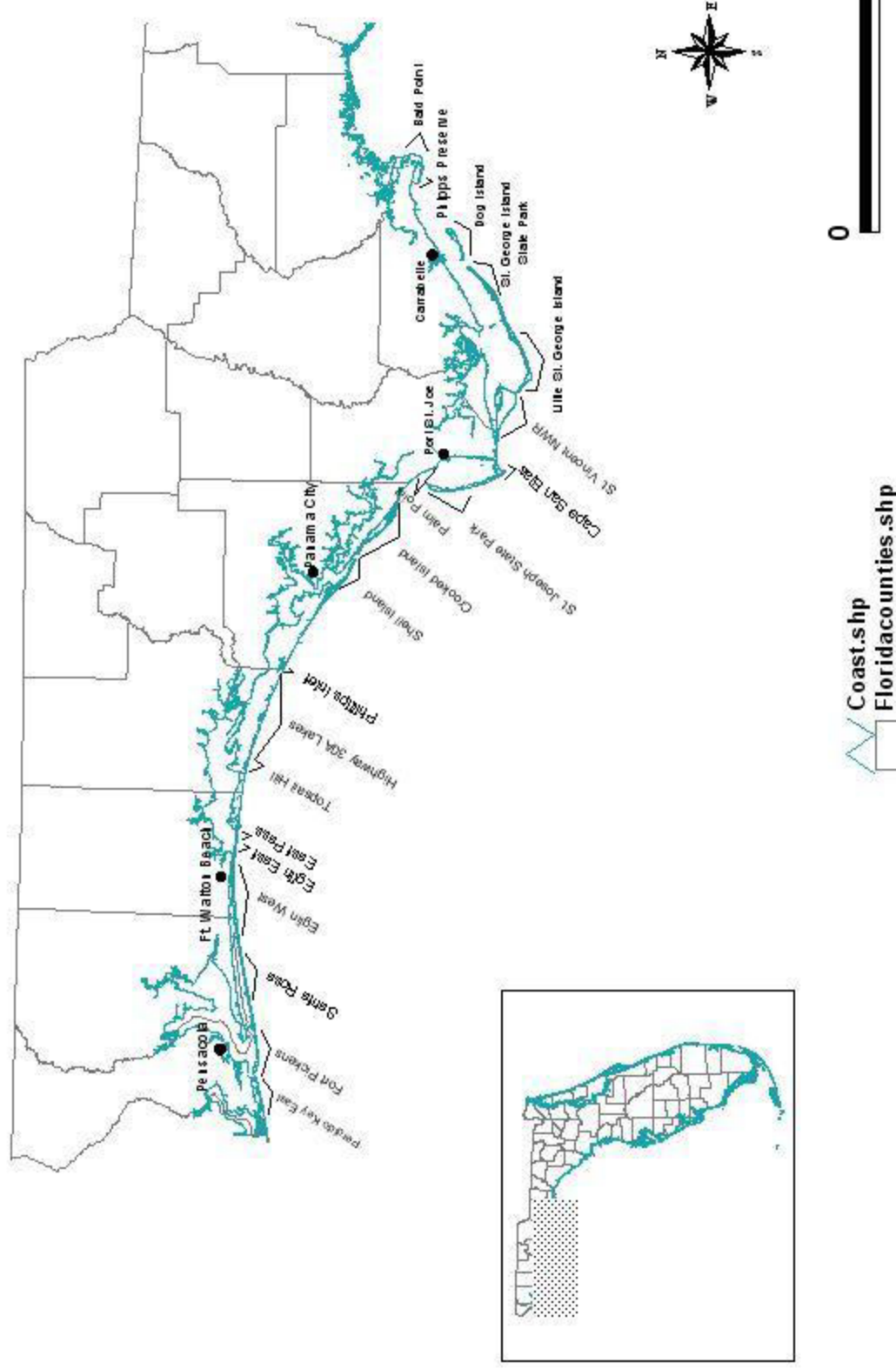


Figure 2. Southwest region geographic areas with breeding snowy plovers.

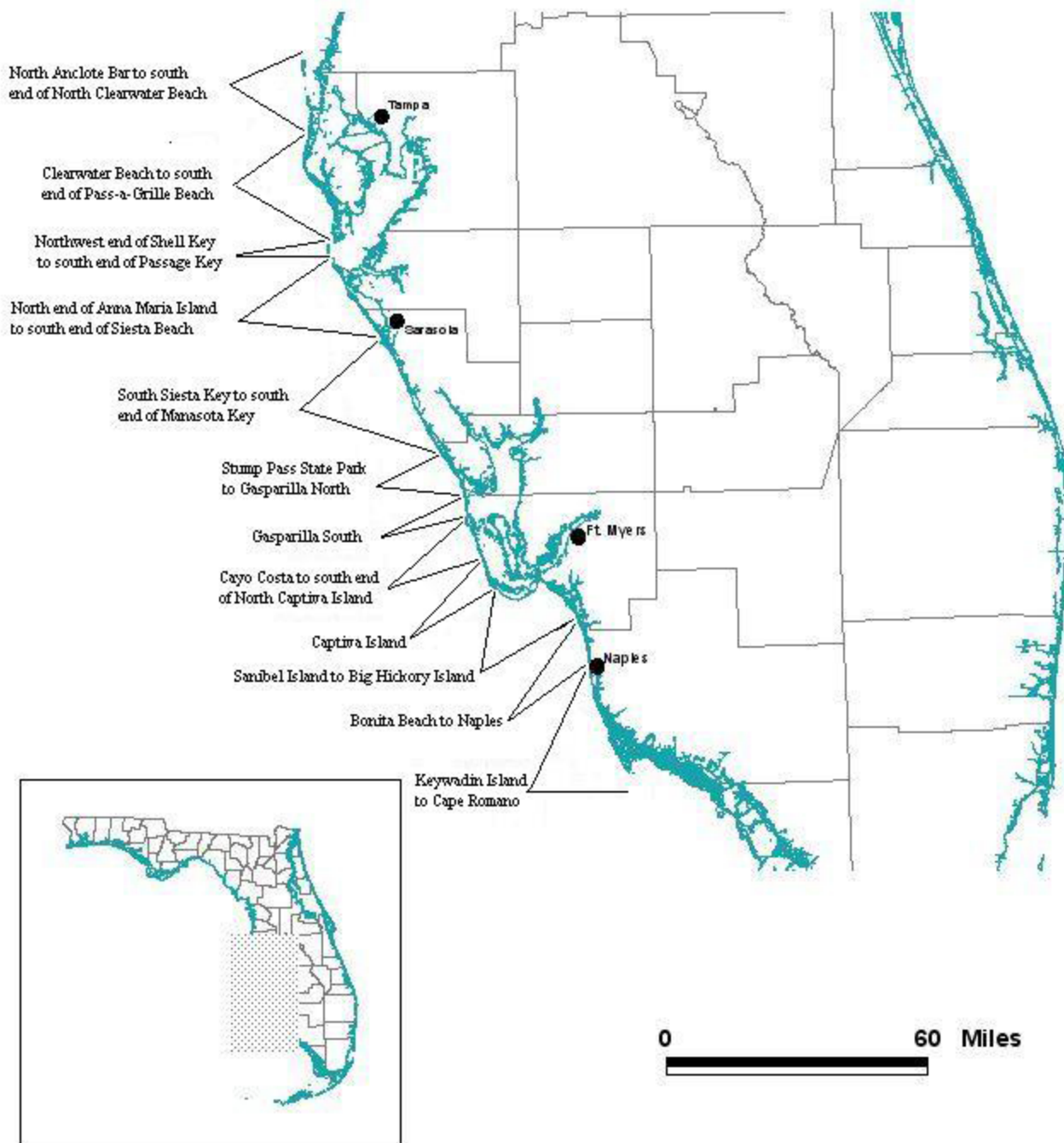


Figure 3 - Locations of Northwest region winter sites used by snowy plovers in 2002.

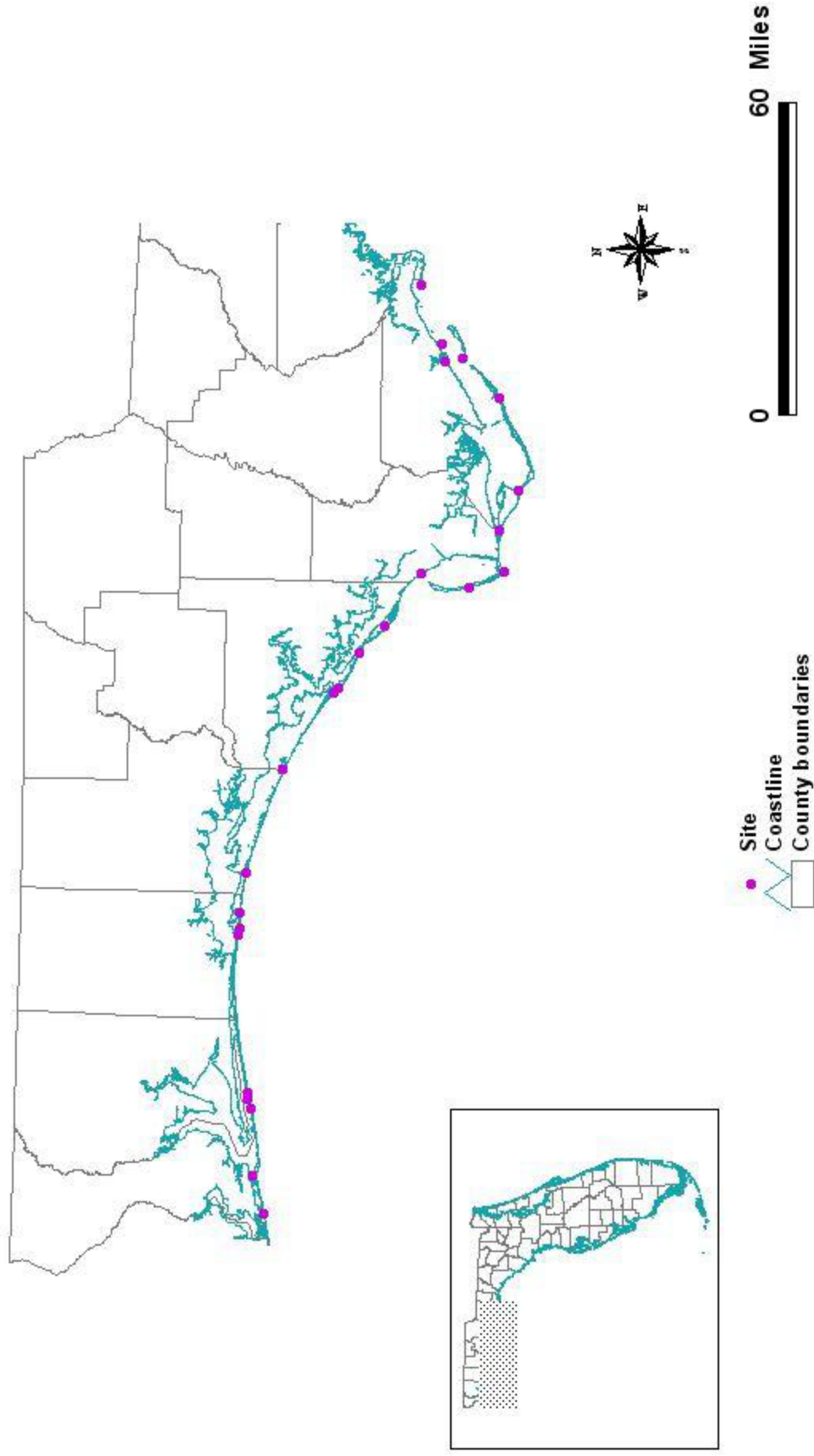


Figure 4. Locations of Southwest region winter sites used by snowy plovers in 2002.

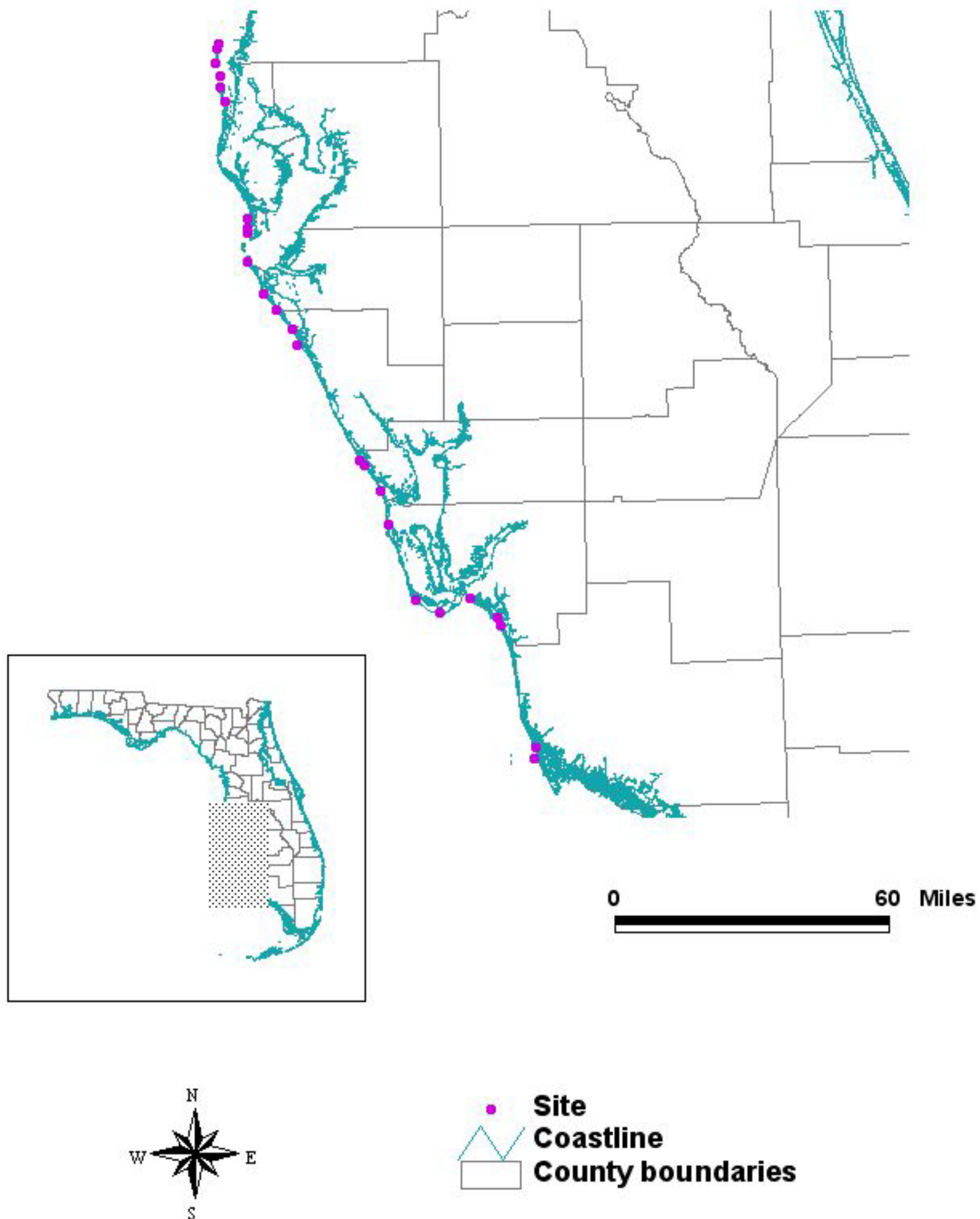


Figure 5. Locations of Northeast region winter sites used by snowy plovers in 2002.

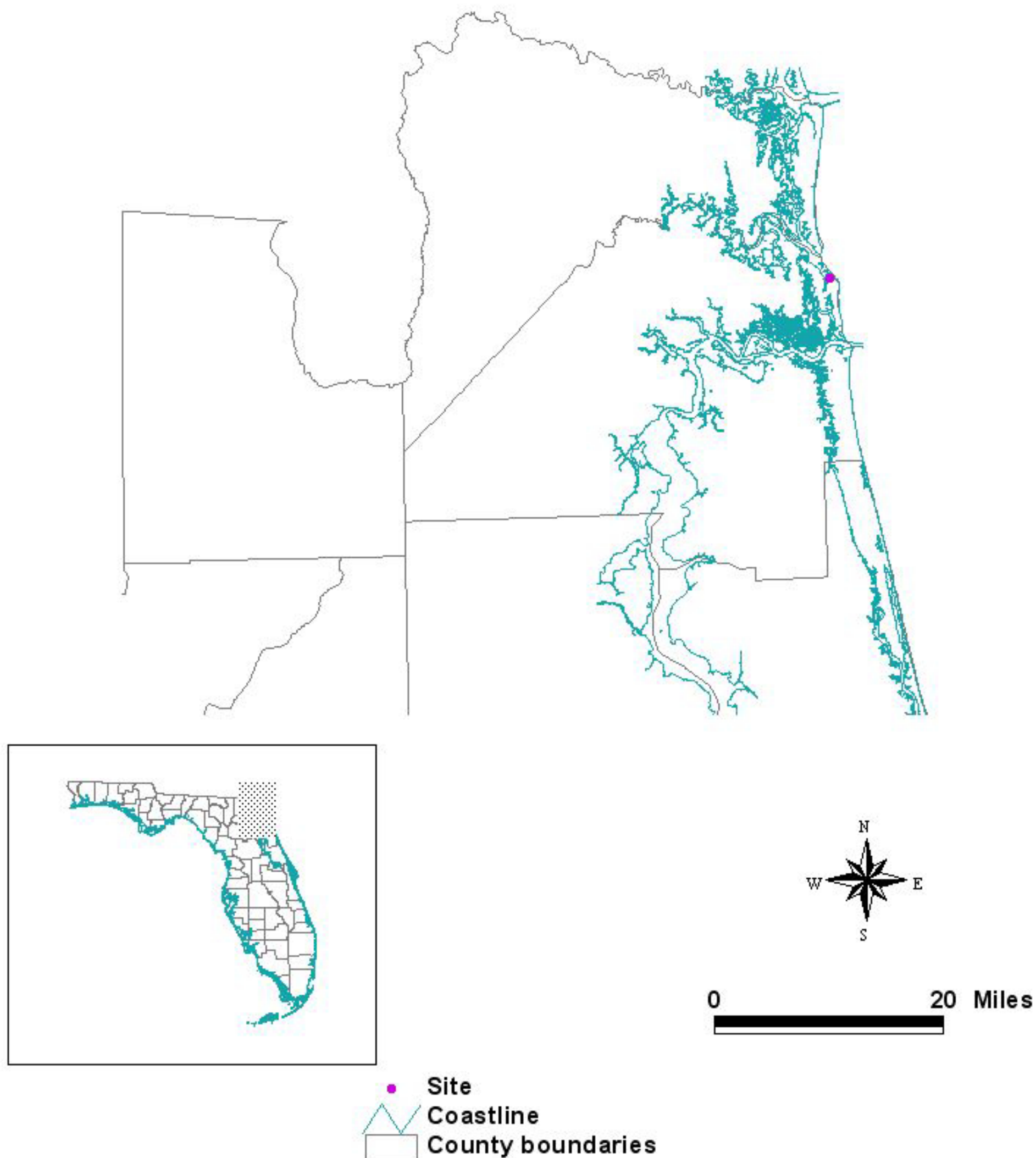


Figure 6. Locations of sites having a large proportion of the 2002 winter snowy plover population.

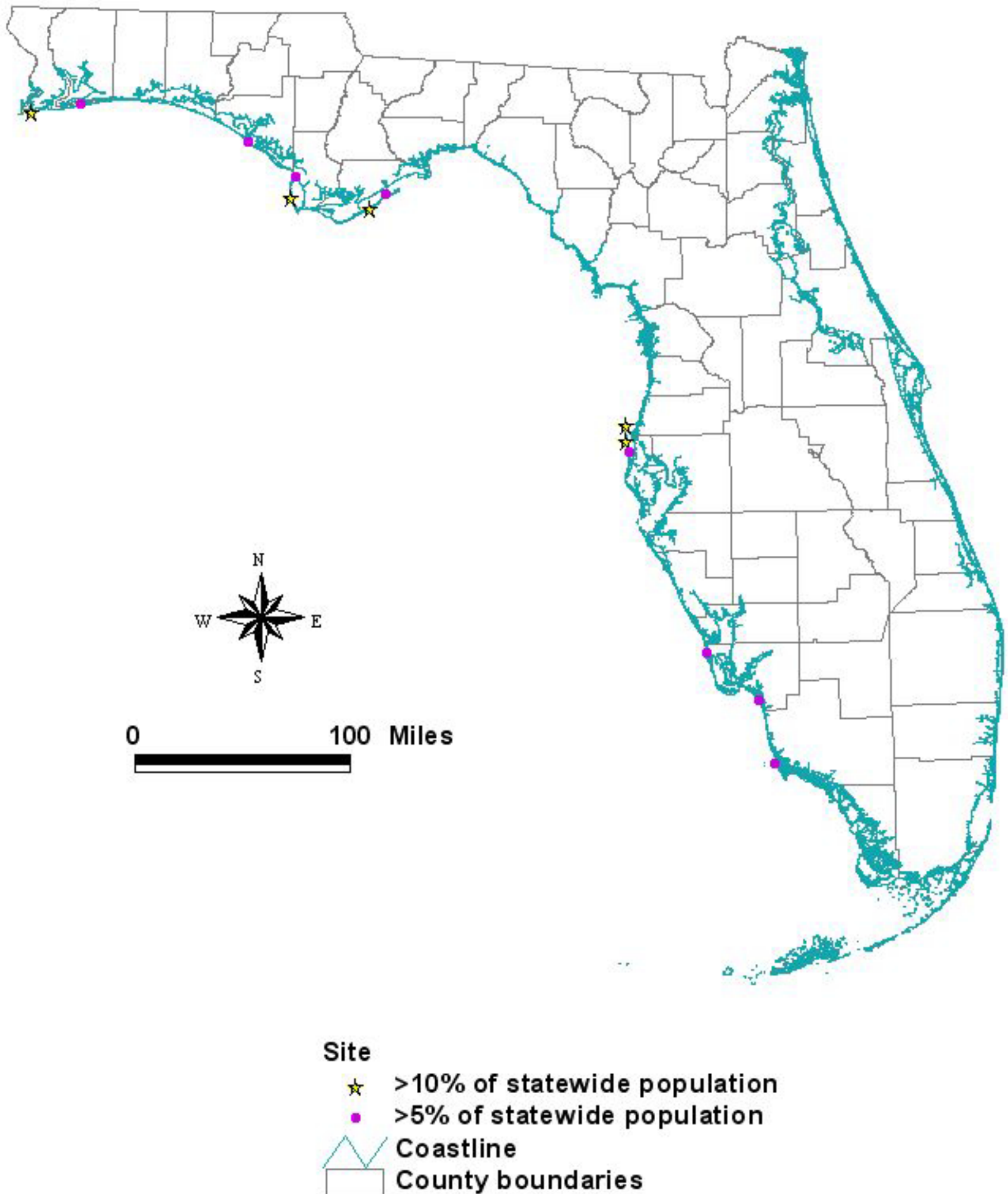


Figure 7. Comparison of the location of sites having a large proportion of wintering snowy plovers in 2002 and 2001.

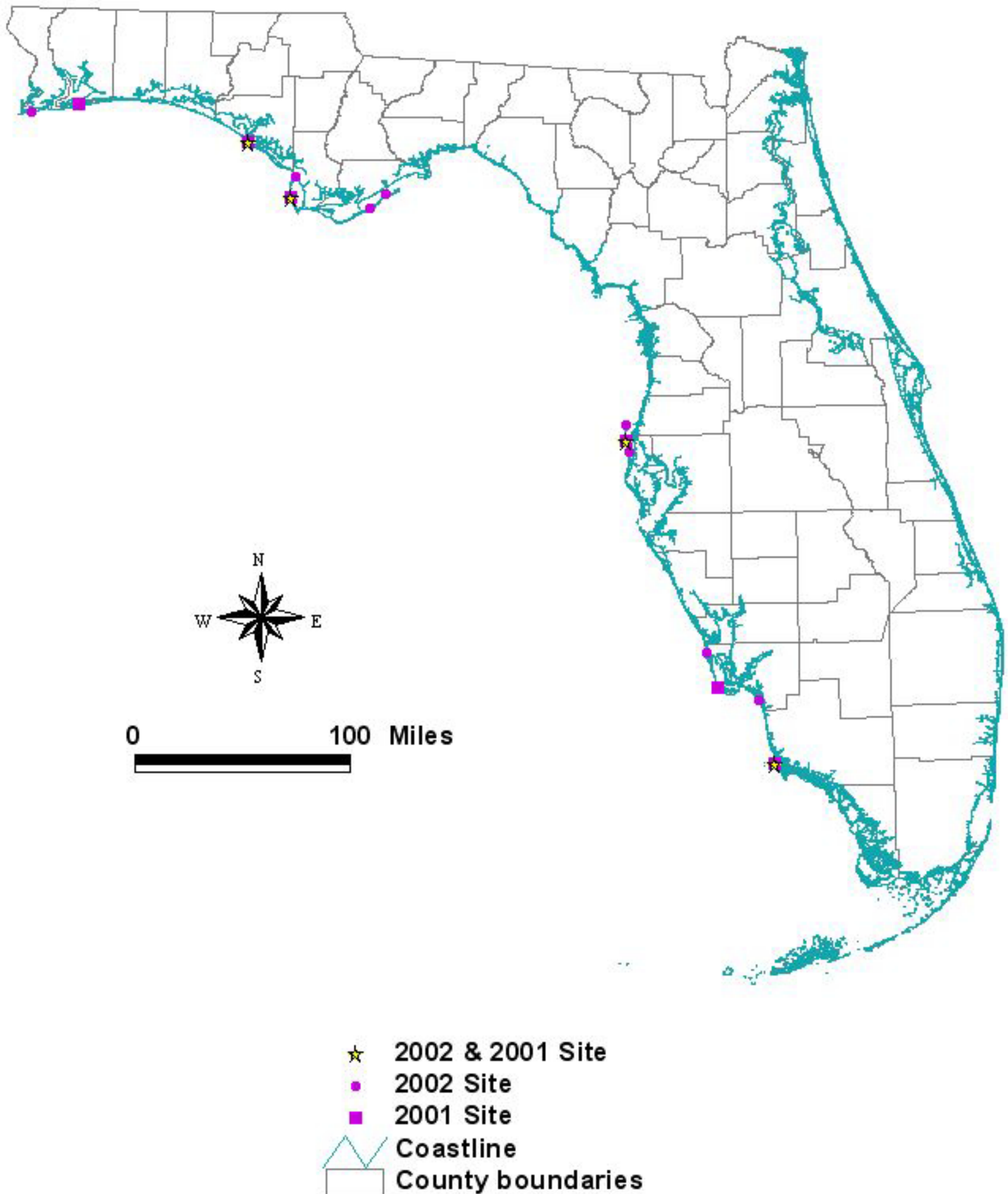


Figure 8 - Alternate 1. Total number of observed snowy plover groups of different sizes.

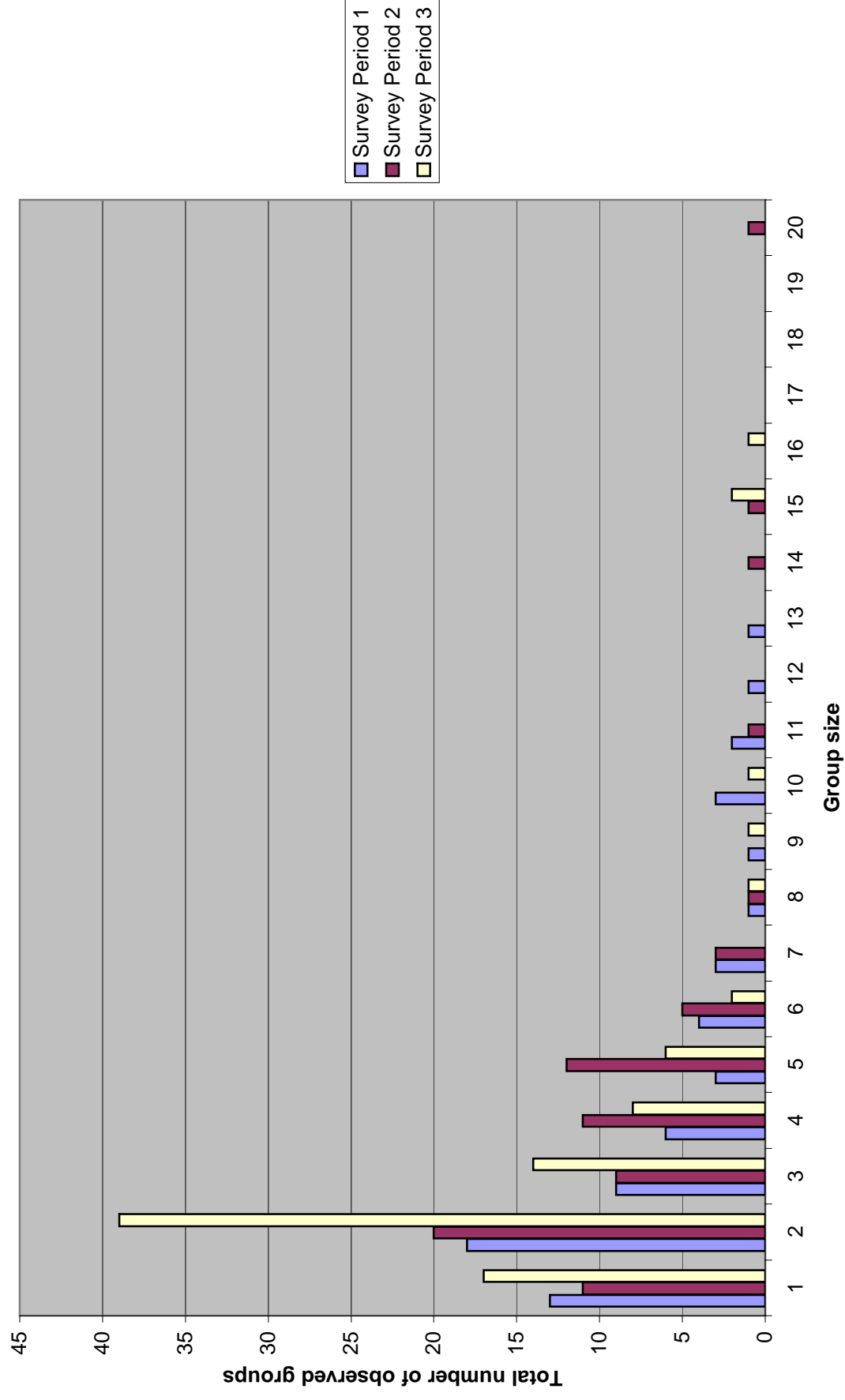


Figure 8 - Alternate 2. Total number of observed snowy plover groups of different sizes.

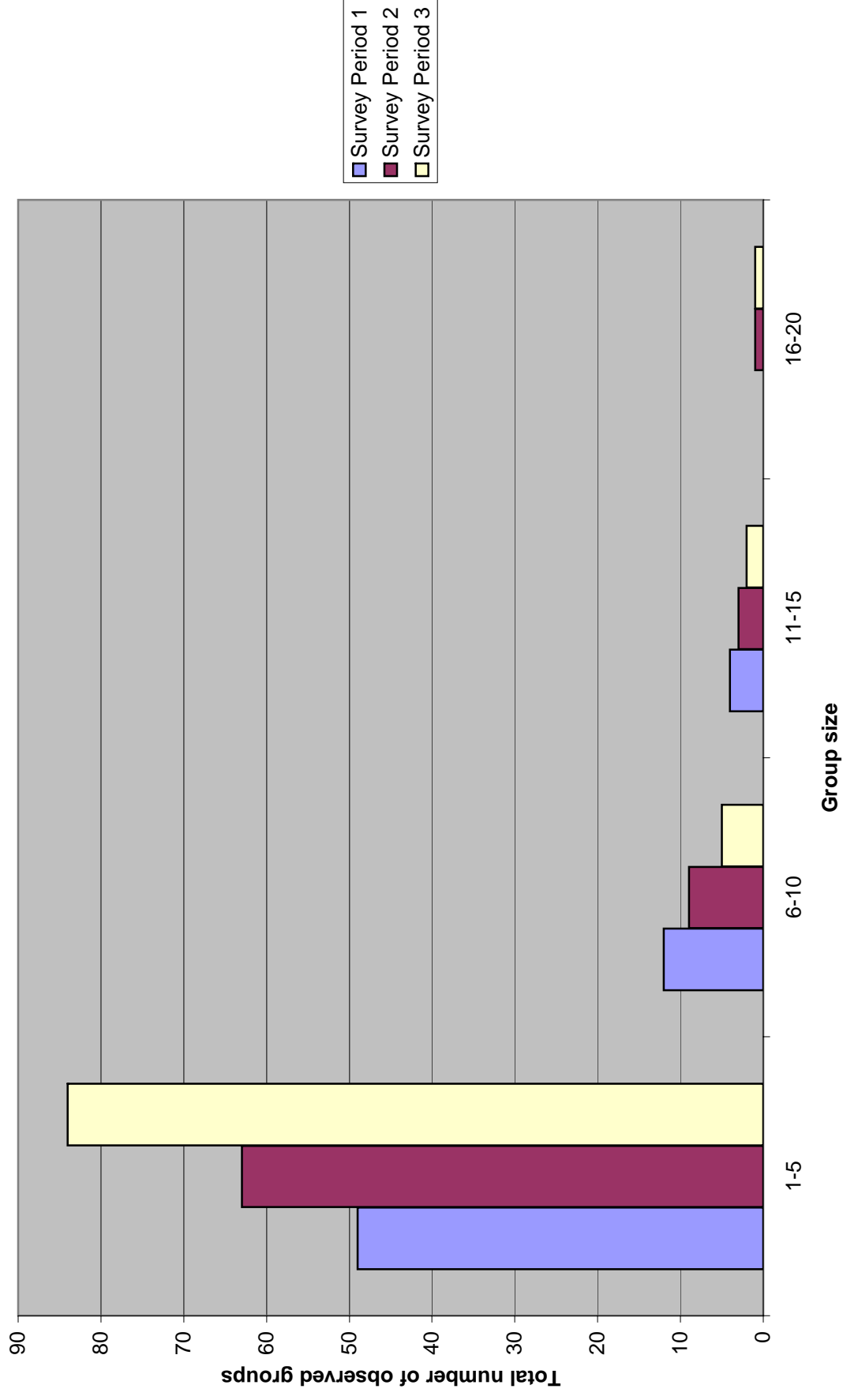


Figure 9. Locations of Northwest region breeding sites used by snowy plovers in 2002.

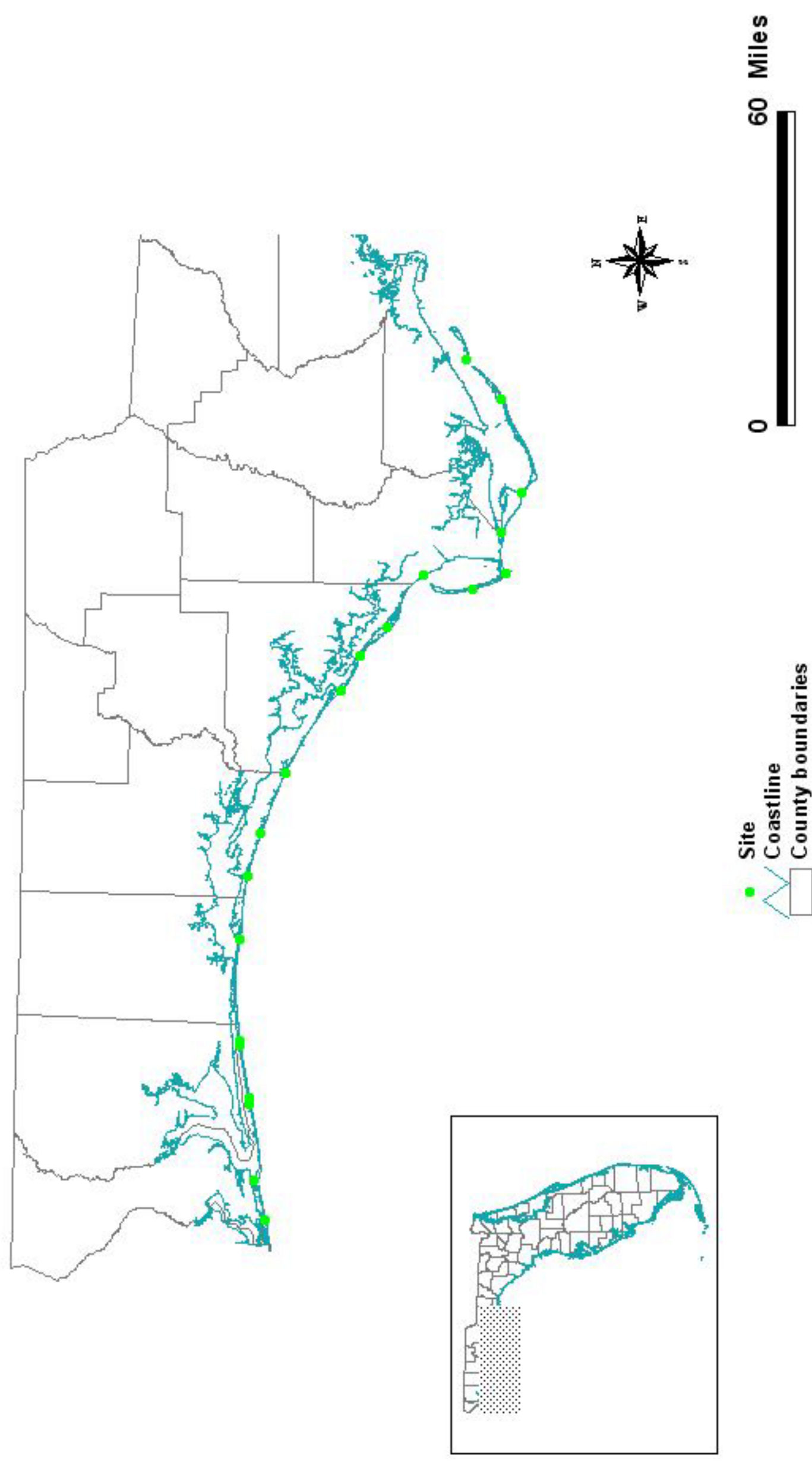


Figure 10. Locations of Southwest region breeding sites used by snowy plovers in 2002.

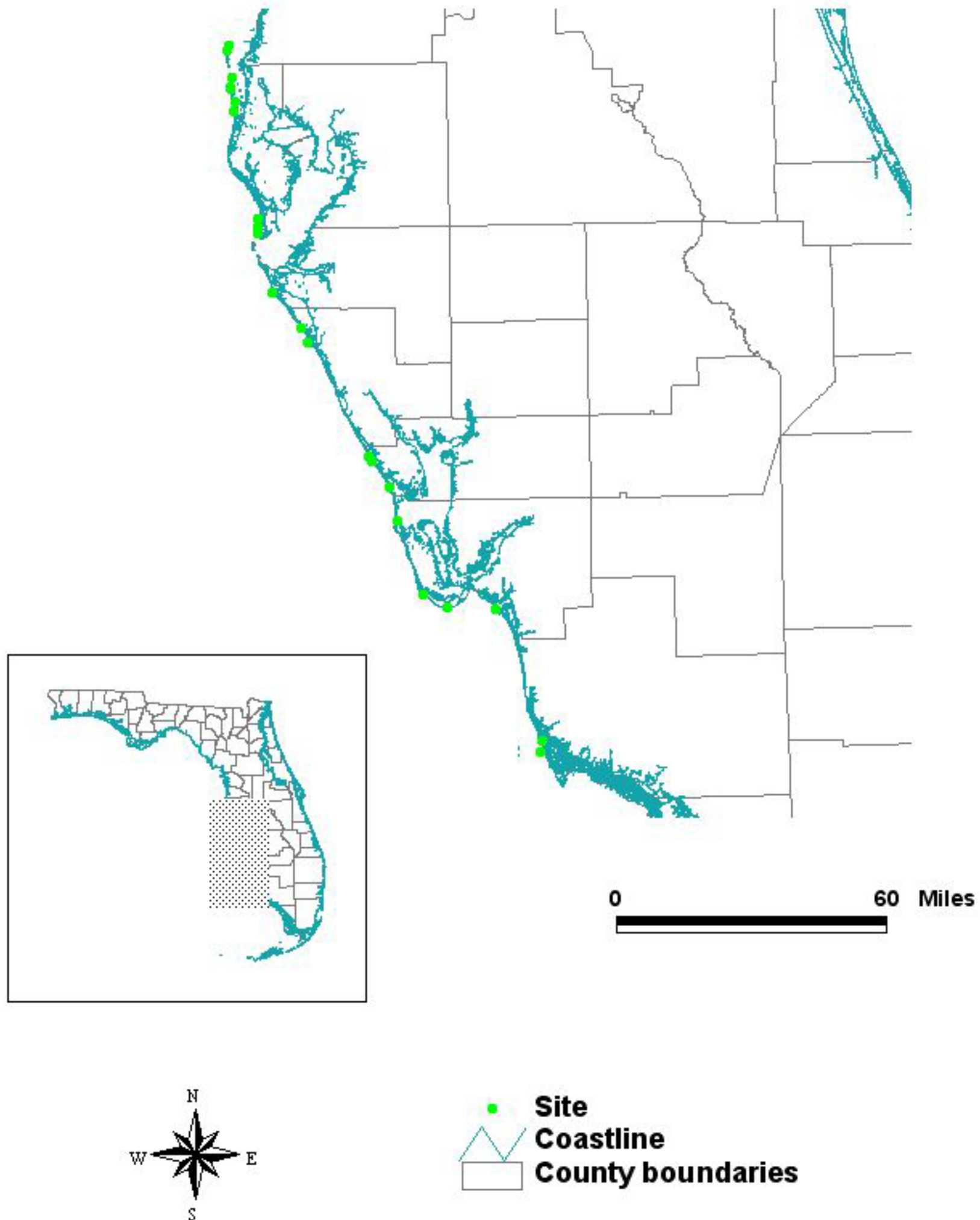


Figure 11. Locations of sites having a large proportion of the 2002 breeding snowy plover population.

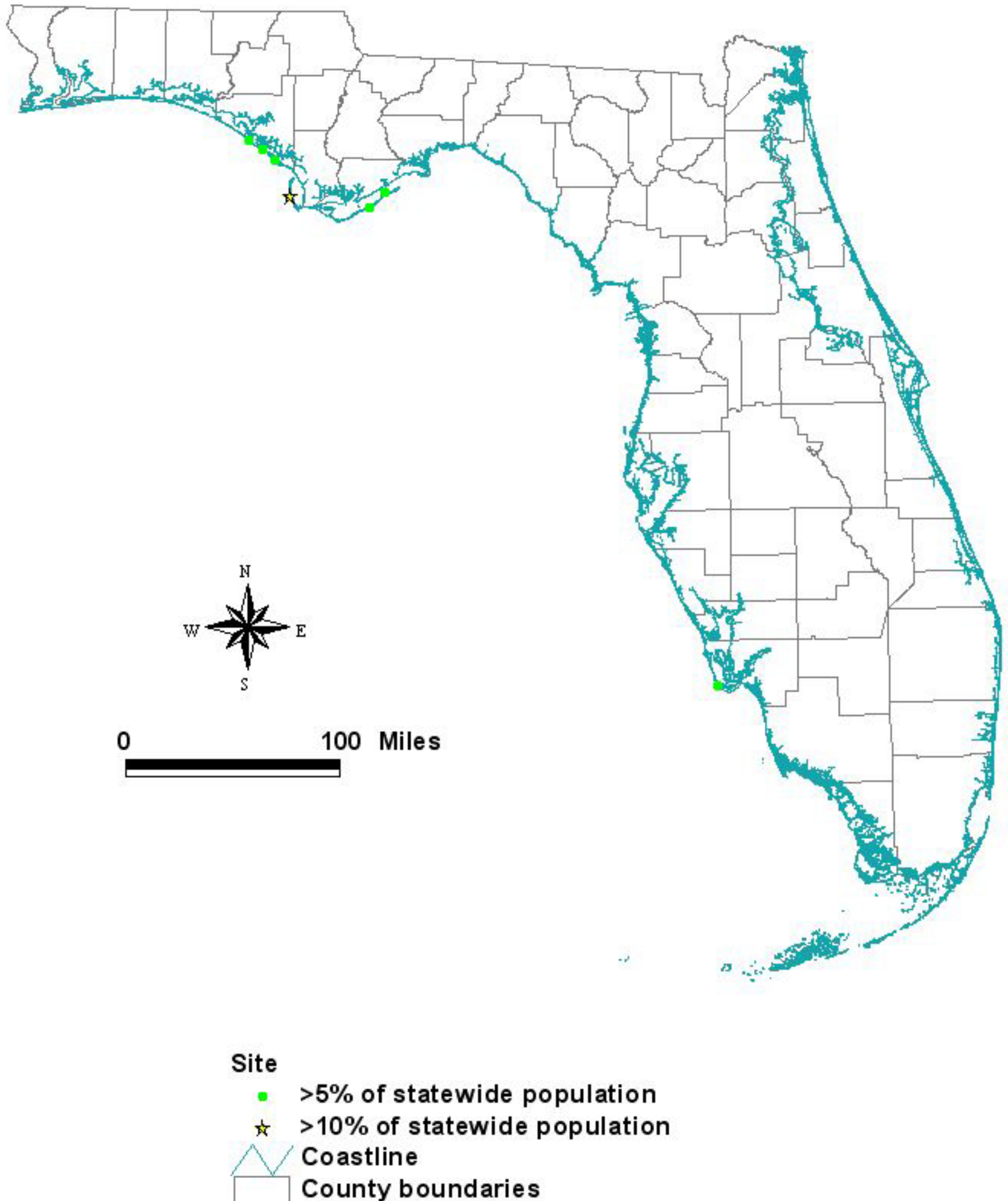


Figure 12. Comparison of the locations of sites having a large proportion of breeding snowy plovers in 2002 and 1989.

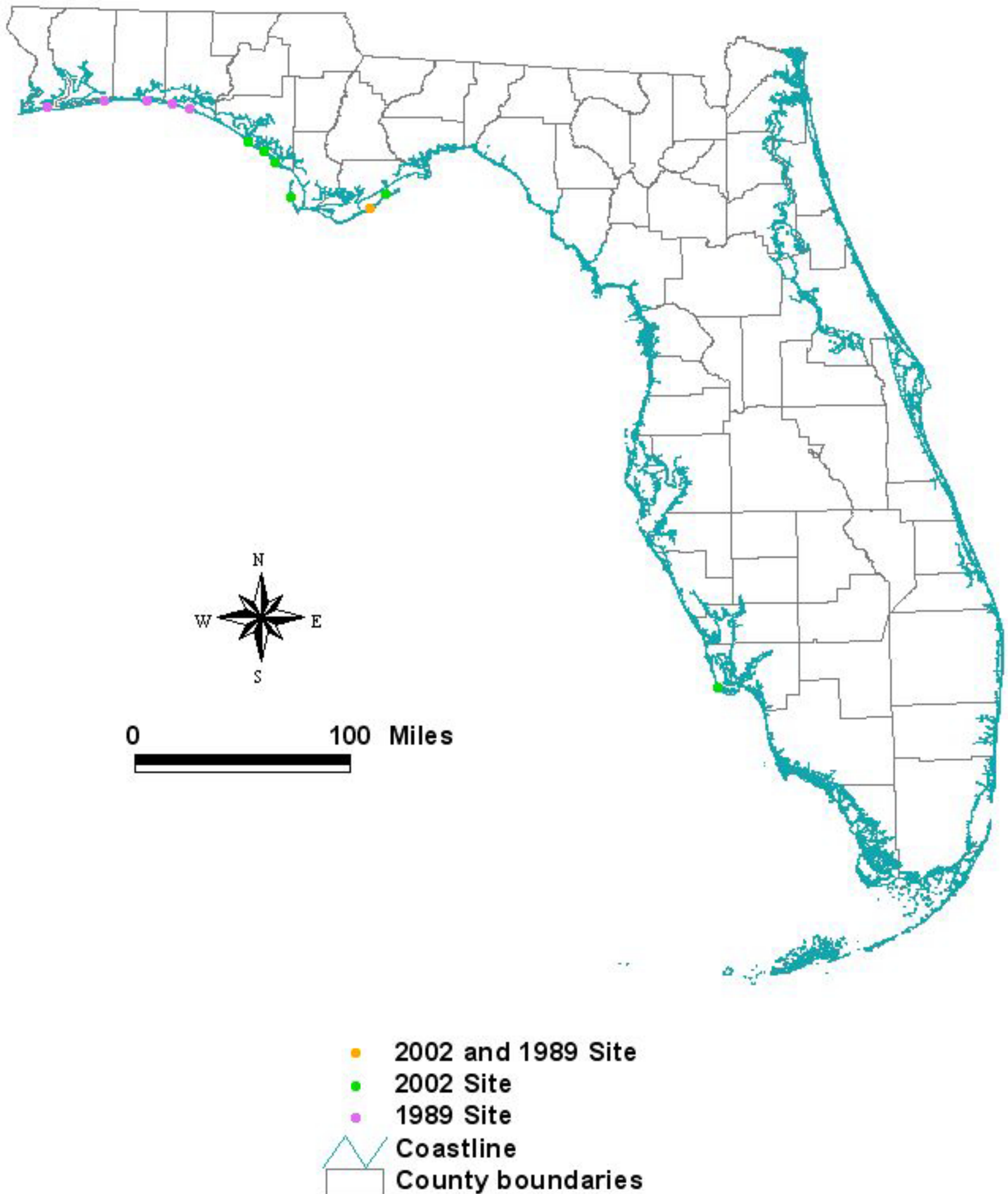


Figure 13. Chronological comparison of the number of snowy plover nests, families, and territorial pairs observed statewide during the 2002 breeding season.

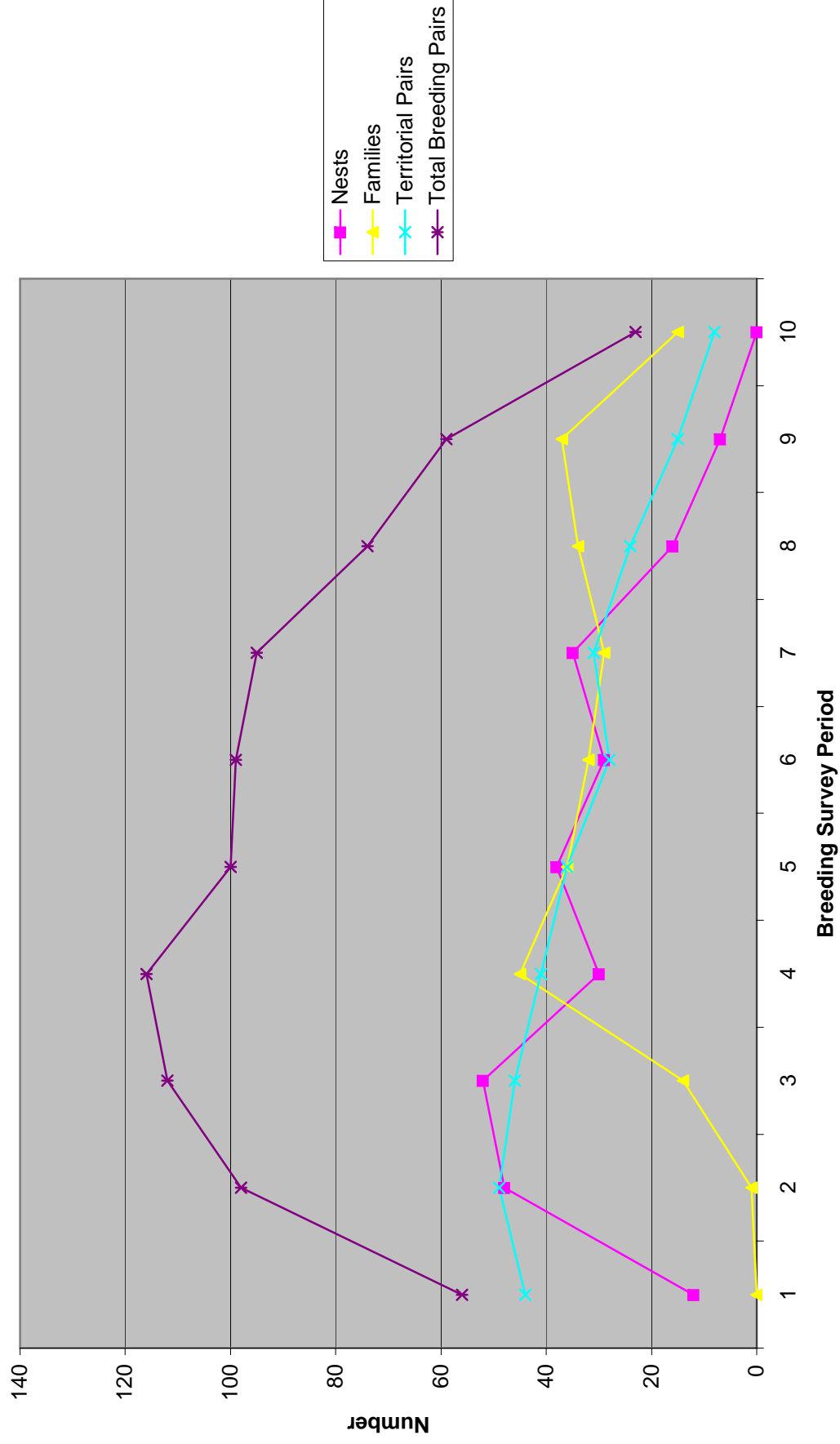


Figure 14. Chronological comparison of the total number of breeding pairs in the Northwest and Southwest regions.

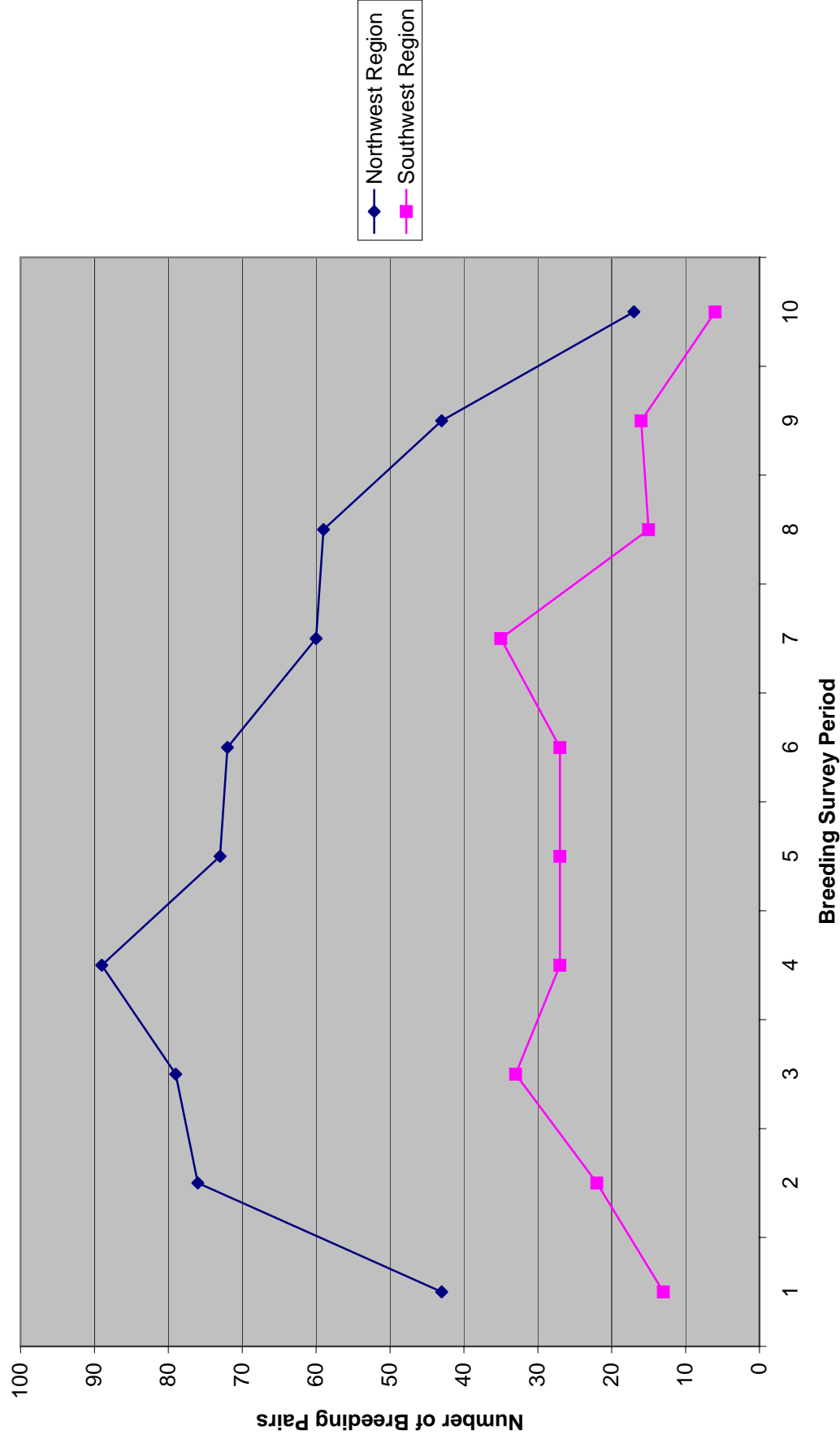
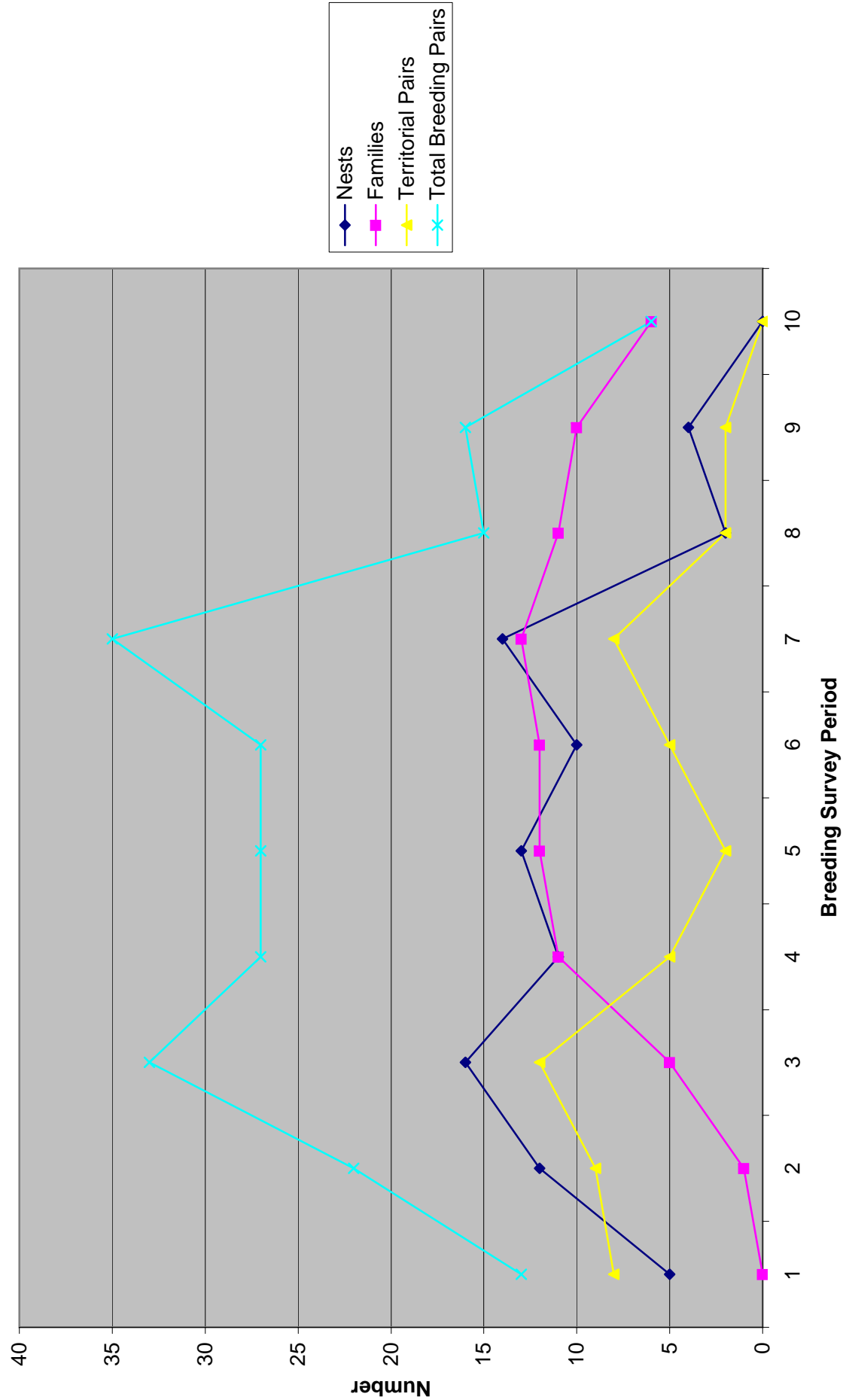


Figure 15. Chronological comparison of the number of snowy plover nests, families, and territorial pairs observed in Southwest Florida in 2002.



Appendix 1. 2002 Snowy plover survey site form.

2002 SNOWY PLOVER SURVEY

Site Form

Site Name _____ Site Number _____

Date _____ Observer(s) _____ County _____

Directions/Access: _____

Lat/Lon:	Location:
1 _____ / _____	1 _____
2 _____ / _____	2 _____
3 _____ / _____	3 _____
4 _____ / _____	4 _____

Land form: Mainland Barrier Island Peninsula other:

Suitability Factors:

Beach width: <5m wide >5m wide

Primary habitat: seawall/riprap sandy beach/interdune mudflat other:

Disturbance : beach raking vehicles/ATV pets pedestrians

Dist. Frequency: <5 times/day 5-20 times/day >20 times/day

Predator tracks? YES NO Type _____

Habitat within 150m of high tide line:

	CONTINUOUS	INTERMITTENT	ABSENT
DUNES			
DEVELOPMENT			
TIDAL POOL			
BLOWOUT/SANDFLAT			

Potential habitat present: Breeding Wintering None

Is suitable habitat: CONTINUOUS or INTERMITTENT

NOTES: _____

Appendix 2. 2002 snowy plover survey winter count form.

2002 SNOWY PLOVER SURVEY
Winter Count Form

Site Name _____ Site Number _____

Date _____ Observer(s) _____ Time Start _____

Tide: Low Mid High (Rising____/Falling____)

# SNPL	Latitude	Longitude	Activity*	Location**

*Activity Codes: 02=Loafing; 04=Feeding; 05=Disturbed; 17=Flying; PO/SH=Possible breeding/Suitable habitat; PR/P=Probable breeding/Pair; PR/T=Probable breeding/Territorial behavior; PR/C=Probable breeding/Courtship or copulation; PR/V=Probable breeding/Nest visiting or building

**Location: Dunes; Foredune; Mid-beach; Tidal Zone; Bay Shoreline; Other

Notes _____

Other notable species to record: **PIPL, WIPL, AMOY**

****Location:** Dunes; Foredune; Mid-beach; Tidal Zone; Bay Shoreline; Other

Notes _____

Appendix 3. 2002 snowy plover survey territory survey form.

2002 SNOWY PLOVER SURVEY
Territory Survey Form

Site Name _____ Site Number _____ Date _____

Observer(s) _____

# SNPL*	Behavior**	Latitude	Longitude	Territory#	Nest?	WIPL?	Comments

*# of SNPL: Record numbers of adults and number of young. For example: 2A/3Y.

** Behavior: NP=Nesting Pair; F=Family; TP=Territorial Pair; TS=Territorial Single; L=Loose Birds

# SNPL	Behavior**	Latitude	Longitude	Territory#	Nest?	WIPL?	Comments

*# of SNPL: Record numbers of adults and number of young. For example: 2A/3Y.

**Behavior: NP=Nesting Pair; F=Family; TP=Territorial Pair; TS=Territorial Single; L=Loose Birds

Appendix 4. 2002 snowy plover survey Wilson's plover observation form.

2002 SNOWY PLOVER SURVEY
WIPL Observations

Site Name _____

Site Number _____

Observer(s) _____

Date _____

# WIPL	Behavior**	Latitude	Longitude	Comments

*# of SNPL: Record numbers of adults and number of young. For example: 2A/3Y.

**Behavior: NP=Nesting Pair; F=Family; TP=Territorial Pair; TS=Territorial Single; L=Loose Birds

Appendix 5. 2002 snowy plover survey nest form.

2002 SNOWY PLOVER SURVEY

Nest Form

Site Name _____ Site # _____ Territory # _____

Observer(s) _____

Nest # _____ Latitude _____ Longitude _____

Nest Contents:

Date	# of eggs	# of chicks	Comments

Nest Characteristics:

Distance to high tide line _____

Nest in view of Gulf? Yes No

Elevation above high tide line _____

Distance to 1° dune line _____

Nest location: Behind In front In dune pocket
 1° dune 1° dune or opening

Distance to nearest vegetation _____

Type of vegetation: Grass Forb Tree Other

Distance to nearest structural debris _____

Type of structural debris _____

Nest lined with shell or debris? Yes No

Location of nearest building _____

Location of nearest public access _____

Notes: _____

Appendix 6. Annotated bibliography for the snowy plover in Florida.

An Annotated Bibliography for the Snowy Plover (*Charadrius
alexandrinus*) in Florida

by

Julie Bennett

and

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Florida Fish and Wildlife Conservation Commission
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In partial fulfillment of Cooperative Agreement No. 1448-40181-01-J-002
(Status and Distribution of the Snowy Plover in Florida)

between

Florida Fish and Wildlife Conservation Commission
and
US Fish and Wildlife Service

August 2001

The first phase of the Cooperative Agreement calls for a literature search and the preparation of an annotated bibliography that updates the information currently available on Snowy Plover biology, distribution, and census techniques. The following bibliography is the result of this search and presents a total of 36 citations.

The Snowy Plover is not a well-studied species anywhere in the world and so recent citations were relatively few. In general we limited our review to the period after 1995, the year of the publication of the *Birds of North America* species account for Snowy Plover (Page et al. 1995). This species account effectively summarizes all published literature on the Snowy Plover through 1995. It omitted one paper specific to capturing and handling Snowy Plovers and a paper with information on the Snowy plover in Puerto Rico that we have included here. We also included citations specific to Florida, some of which were not included in Page et al. (1995) and which summarize pertinent information on the species' current status in the state. We have also included several older citations that illustrate the controversy over the taxonomic status of the Cuban Snowy Plover.

Taxonomy

The cooperative agreement covers surveys of Florida populations of the Snowy Plover, referred to as Cuban Snowy Plover (*C. a. tenuirostris*) by a number of sources. The validity of this taxon is disputed. As summarized by Page et al. (1995), three subspecies have been recognized for the Americas: *C. a. occidentalis* is resident on the west coast of South America; *C. a. tenuirostris* for birds on the Gulf of Mexico coast east of Louisiana through Florida, the Bahama Islands, north coast of the Yucatan Peninsula, Greater and Lesser Antilles, and islands off the north coast of Venezuela; and *C. a. nivosus* for breeding birds elsewhere in the US and Mexico, including: coastal California and Baja California; locally in the Great Basin of California, Oregon, Nevada, and Utah; very locally in southern Saskatchewan, central Montana, southern Wyoming, central and eastern Colorado, southern Arizona; sparsely but widely over southeast New Mexico and east through north central Texas, central Oklahoma and central Kansas; the southern Texas coast into northeast Mexico; and the central Mexican plateau (AOU 1957, Cramp 1983). Others (Oberholser 1974, Johnsgard 1981, Jacobs 1986, Gore 1996) have stated that *tenuirostris* includes birds in coastal Texas, northeastern Mexico, as well as birds of the interior Great Plains.

Subspecies *tenuirostris* is distinguished from *nivosus* by its paler dorsal coloration (Page et al. 1995), but the validity of *tenuirostris* has been questioned (Blake 1977), and many authors do not recognize it among New World subspecies (e.g., Hayman et al. 1986, Sibley and Monroe 1990).

The genetic relationships among North American Snowy Plover populations and putative subspecies has implications for conservation action including listing by the US Fish and Wildlife Service under the Endangered Species Act and by the states. Gorman (2000) investigated mtDNA and inter-simple sequence repeat loci in *tenuirostris* and *nivosus*, recognizing the ranges of the subspecies as those described above from Page et al. (1995). Gorman concluded that Greater Antillean birds, represented only by samples

from Puerto Rico were clearly differentiated from mainland birds in Florida. Furthermore, Florida birds were much more closely related to other continental populations of *nivosus* than to Puerto Rican *tenuirostris*. Among birds east of the Rocky mountains, Texas coastal and Great Plains birds appeared to be more closely related to other eastern birds than birds west of the Rocky Mountains.

The results argue for three management units: west of the Rockies, east of the Rockies, and Puerto Rico. Gorman admits that, in the absence of further sampling, it is not clear whether all Snowy Plover populations in the West Indies and Bahamas would fall in the same management unit as that of Puerto Rico or the eastern mainland. Differentiation among the eastern continental US populations is apparently insufficient to warrant separate management units. Thus, these results suggest that Snowy Plovers east of Louisiana, including Florida Snowy Plovers, would be grouped in the same management unit along with Great Plains and other Gulf coast populations. However, Gorman also suggests that a conservative approach would be to adopt smaller management units based on demographic considerations. That might argue for eastern Gulf birds being in their own management unit.

Populations

Breeding.—The great majority of the eastern mainland population breeds and winters in Florida where they are restricted to coastal beaches. Florida's breeding birds probably are mostly permanent residents, but there is some evidence that at least a few birds leave the state (J. Gore, pers. commun.). A 1989 survey found 145 pairs of Snowy Plovers from the Alabama-Florida state line in Escambia County east to Alligator Point in Franklin County and an additional 22 pairs at scattered sites from Horseshoe Key, Pinellas County south to Marco Island, Collier County (Chase and Gore 1989). Later surveys suggest that the number of breeding birds may be somewhat higher, 170-200 pairs, including approximately 30 pairs on the Peninsular Gulf coast (Gore 1996). An additional 30 pairs breed in coastal Mississippi and Alabama (Chase and Gore 1989). This is the most current information on the breeding population in the eastern Gulf of Mexico.

Loss of nesting habitat has apparently led to a decline in Snowy Plover breeding populations in the southeast (Gore 1996). Snowy Plovers in the upper Texas coast may have undergone a range contraction since the 1930s when they were noted as common year round at Bolivar Flats and Freeport. However, no breeding Snowy Plovers have been found in suitable habitat on the upper Texas coast in recent years, and some believe they may never have been common there (see Gorman and Haig, in press). There have been no systematic surveys in the Bahamas or the Caribbean, although there have been no significant declines among the few birds that breed at Cabo Rojo Flats in Puerto Rico (Collazo et al. 1995).

Wintering.-A statewide shorebird survey conducted in 1993-94 found approximately 100 Snowy Plovers wintering in Florida (Sprandel et al. 2000). However, these surveys were focused on large or diverse aggregations of shorebirds and hence were biased against solitary species like the Snowy Plover. Winter counts conducted in concert with the International Piping Plover Survey suggest the true numbers are higher. A winter count made during a 1988 piping plover (*Charadrius melodus*) survey tallied 215 birds in Florida (J. Nicholls, pers. commun in Chase and Gore 1989). A total of 311 Snowy Plovers were tallied during the 2001 Piping Plover survey, with 66.2% being found in panhandle counties (US Fish and Wildlife Service 2001).

Trapping and Banding

The one citation we provide on trapping, handling and banding Snowy Plovers (Hill and Talent 1990) provides some good information that would prove useful in a project in which banding and marking birds were major objectives. The proposal adopted under the Cooperative Agreement calls for banding of chicks as possible. On considering further the work schedule necessary to adequately map the distribution of Snowy Plovers and their territories in Florida, the personnel available for the work, and the rapidity with which plovers leave the nest after hatching, we have elected not to pursue banding in this study. Nests have to be followed very carefully in order to observe hatching and to band the chicks before they permanently leave the nest, often within a few days (Gore 1996). We feel that it is unlikely that we will have the opportunity to band many, if any, chicks.

ANNOTATED BIBLIOGRAPHY

Amat, J. A., R. M. Fraga, and G. M. Arroyo. 1999. Brood desertion and polygamous breeding in the Kentish plover, *Charadrius alexandrinus*. Ibis 141:596-607.

Rates of brood desertion and polygamy vary with geographic area and breeding season. When renesting females did not seem selective about mate choice and mated with any available male. Male plumage characteristics led observers in southern Spain to the conclusion that renesting males were of lower quality than first nest males. Clutch sizes and egg characteristics were similar in both nests. Polygamy may be an important breeding strategy to increase lifetime breeding success of the Snowy (Kentish) plover.

Amat, J. A., R. M. Fraga, and G. M. Arroyo. 2001. Intraclutch egg-size variation and offspring survival in the Kentish plover, *Charadrius alexandrinus*. Ibis 143:17-23.

A test of the hypothesis that female plovers allocated resources preferentially to the eggs with the greatest survival chance. This hypothesis was not supported. The change in egg size with laying order was not consistent between successive clutches of renesting females. There may be a trade off between egg size and fecundity. Larger eggs tend to produce heavier chicks more likely to be recruited into the breeding population but the larger the egg, the longer the time before the next clutch could be laid by the female (southern Spain).

Amat, J. A., R. M. Fraga, and G. M. Arroyo. 1999. Replacement Clutches by Kentish Plovers. *Condor* 101:746-751.

Plovers along with many other birds can renest in a nesting season. This is an important breeding strategy where predation is high and replacement clutches can be laid if the previous one is lost. Renesting plovers were observed to move considerable distances from the first nest to the renesting site at the study site in southern Spain. The limiting factor in renesting is time, but Snowy Plovers have been known to nest up to five times in a single season in areas with a longer nesting season.

Amat, J. A., R. M. Fraga, and G. M. Arroyo. 1999. Reuse of Nesting Scrapes by Kentish Plovers. *Condor* 101:157-159.

While many birds invest much energy in nest construction, the nest of Snowy Plover is relatively simple to build and takes much less energy than other birds' nests. However this study found that 6% of nests are reused. This is most common later in the breeding season when there is little rain in the southern Spain plovers in this study and the normally soft substrate is harder and more difficult for the plovers to work with. No differences in breeding success were detected in pairs that reused nests.

American Ornithologists' Union. 1957. The AOU Check-list of North American Birds. 5th ed. American Ornithologists' Union, Washington, DC.

Species account for Snowy Plover recognizes *C. a. tenuirostris* and *C. a. nivosus* in the continental United States.

American Ornithologists' Union. 1998. The AOU Check-list of North American Birds. American Ornithologists' Union, Washington, DC.

Species account for Snowy Plover reviews range of subspecies. *C. a. tenuirostris* is lumped with *nivosus*.

Below, T. H. 1985. Shorebirds in South-west Florida. Wader Study Group Bulletin. 44: 40-41.

An analysis of data collected over a 10-year period found Snowy Plovers most abundant in the winter months on Marco Island. Study results at Marco Island were compared to CBC data collected from 9 sites along Florida's coast.

Blake, E. R. 1977. Manual of Neotropical birds, Vol. 1. University of Chicago Press, Chicago, Illinois.

Questions validity of *tenuirostris*.

- Chase, C. A., and J. A. Gore. 1989. Snowy plover breeding distribution. Florida Game and Freshwater Fish Commission. Tallahassee, FL. 23pp.

A monitoring program conducted January - August 1989 along the Gulf Coast of Florida and Alabama. The estimated population in 1989 along the eastern Gulf Coast was approximately 200 breeding pairs, with at least 167 pairs breeding along the Gulf Coast of Florida. Nearly all nests were found where human activity was low and were often found near Least Tern colonies. This report also includes recommended conservation actions, including fencing off and posting nesting areas, prohibiting dogs, reducing vehicle traffic on beaches, and conservation of undeveloped beach habitat.

- Collazo, J. A., B. A. Harrington, J. S. Gear, and J. A. Colon. 1995. Abundance and distribution of shorebirds at the Cabo Rojo Salt Flats, Puerto Rico. *Journal of Field Ornithology* 66:424-438.

- Cramp, S. 1983. Handbook of the birds of Europe, the Middle East and North Africa. Vol. 3. Oxford University press, New York, NY.

Includes a discussion of the ranges of Snowy Plover, including the New World subspecies. Accepts *C. a. tenuirostris* for plovers east of Louisiana through Florida, the Bahamas, Greater and Lesser Antilles, northern Yucatan Peninsula, and islands off Venezuela.

- Gore, J. A. 1996. Cuban Snowy Plover. Pp. 73-80 in *Rare and endangered biota in Florida*. Vol. 5 (J.A. Rogers, H.B. Kale, and H. T. Smith, eds.). University Press of Florida, Gainesville, FL.

A summary of information on the Cuban Snowy Plover including description, behavior, threats, and distribution. The author indicates *C. a. tenuirostris* breeds along the coast of the Gulf of Mexico from Mexico and Texas to Florida and throughout the Caribbean, it also breeds locally on interior plains from Kansas and Colorado south to New Mexico and northcentral Texas. Although the author cites AOU 1983 (Check-list of North American birds, 6th ed. American Ornithologists' Union, Washington, DC) as the basis for this, AOU (1983) does not delineate subspecific ranges for the Snowy Plover. Citing Chase (pers. comm.), the author states that the Florida population is 170-200 pairs with 30 of those in southern Florida. Threats to the Cuban Snowy Plover include loss of nesting habitat and increased recreational activity on beaches by humans.

- Gorman, L. R. 2000. Population differentiation among Snowy Plovers (*Charadrius alexandrinus*) in North America. M.S. thesis, Oregon State University, Corvallis, OR.

An examination of the variation in mitochondrial DNA in order to describe the population structure and phylogeography of Snowy Plovers. The results point to

the Florida population being more closely related to western populations of *C. a. nivosus* than to the Puerto Rican population of *C. a. tenuirostris*. The Great Plains and Texas Snowy Plovers appear to be more closely related to eastern rather than western populations. The author suggests managing populations according to their genetics not their demographics and also calls for a re-examination of subspecies boundaries for Snowy Plovers.

Gorman, L. R and S. M. Haig. In press. Distribution and abundance of Snowy Plovers in eastern North America, Caribbean, and Bahamas. *Journal of Field Ornithology*.

A summary of information on distribution and abundance in the eastern United States, Caribbean, and the Bahamas. Serious concerns about Snowy Plover status indicate a need for more population surveys and estimates. Protocols used for the International Piping Plover Census might also be used in monitoring Snowy Plover populations. Information provided by such a survey would produce much needed data on the distribution, abundance, dispersal patterns, and population trends of the Snowy Plover across its range.

Hayman, P., J. Marchant, and T. Prater. 1986. *Shorebirds: An identification guide*. Houghton Mifflin Co., Boston, MA.

This identification guide considers all Snowy Plovers in the United States and the Caribbean to be of the subspecies *C. a. nivosus*. Only two subspecies are recognized in the Americas. The other is *C. a. occidentalis* found in coastal Peru and Chile.

Hill, L.A., and L.G. Talent. 1990. Effects of capture, handling, banding, and radio-marking on breeding Least Terns and Snowy Plovers. *Journal of Field Ornithology* 61:310-319.

A technique was evaluated that was supposed to minimize the adverse effect of trapping, handling, banding, and radio-marking on Least Terns and Snowy Plovers. Both species are sensitive to human disturbance and are listed with special status throughout their ranges. The technique employed a T-shaped spring trap used at the edge of colonies to minimize disturbance, masking birds during handling, freeing birds from release boxes, and limiting holding time to less than 30 minutes. These techniques had little negative effect on either species breeding, with less than 5% nest desertion and no injuries to birds.

Hughes, K., S. Ostojka, and A. Rumsey. 1997. Nest site selection by Snowy Plovers at the Guadalupe Nipomo Dunes Preserve. B.S. senior paper. California Polytechnic State University, San Luis Obispo, CA.

This study examined 3 ecological factors and their role in nest success of Snowy Plovers. These factors were camouflage rating of the nest and eggs, distance from the nest to the largest foredunes, and distance from the wrack line to the nest.

None of the factors were proven to affect nest survivorship in the study area. Suggestions for improving study methods and for possible future studies are given.

Jacobs, R. A. 1986. Snowy plover (*Charadrius alexandrinus*). Wildlife Resources Management Manual, U.S. Army Corps of Engineers, Washington, D.C.

A comprehensive species account. The distribution of *C. a. tenuirostris* is reported as Cuba, St. Croix, along the Gulf of Mexico from western Florida to Texas and northeastern Mexico, interior Texas, and islands off the Venezuelan coast, based on Oberholser (1974). Predation, adverse weather, recreational development, shoreline modification, urban and industrial development, and encroachment of vegetation into areas preferred by plovers, are given as reasons for the Snowy Plover decline.

Johnsgard, P. A. 1981. The plovers, sandpipers, and snipes of the World. University of Nebraska Press, Lincoln, NE.

Includes descriptions of the various subspecies and their ranges. The author recognizes *C. a. tenuirostris* as a subspecies and gives its range as the salt plains of the southern Great Plains, the Gulf Coast, the West Indies, and islands off Venezuela.

Keith, T. 1997. The nesting preference of the Snowy Plover. B.S. senior paper. California Polytechnic State University, San Luis Obispo, CA.

Several variables were recorded to determine nesting preference of Snowy Plovers. Variables included location of the nesting site, clutch size, nesting materials used, objects around the nests, and density of vegetation near the nest. Stones, shells, and sea rockets were the most common objects in or around nests. Suggestions were also given on improving Snowy Plover nesting habitat in the study area.

Mabee, T. J. 1997. Using eggshell evidence to determine nest fate of shorebirds. Wilson Bulletin 109:307-313.

Eggshell evidence was used to classify nest fate. This study establishes a standard basis for determining nest fate to make comparisons between studies easier. As part of the study Piping Plover, Snowy Plover, and Killdeer nests were examined for shell fragment and predator sign. All successful Snowy Plover nests were found to have eggshell fragments and eggshell membranes separated from the shell. For Snowy Plovers, eggshell fragments were the best predictor of nest success and large eggshell parts (tops, bottoms, or pieces) and eggshell membrane was the best predictor of failed nests.

Mabee, T. J., and V. B. Estelle. 2000. Assessing the effectiveness of predator exclosures for plovers. *Wilson Bulletin* 112:14-20.

Predator exclosures were not effective at increasing nest success. The survival rates of Snowy Plovers nests with exclosures were the same as the nests without them. The authors point to a number of reasons for this outcome including the predator exclosures used only protect the plovers from large avian and mammalian predators and that Colorado has many reptilian and small mammalian predators. The authors also question the validity of previous studies that found predator exclosures increased nest success.

Oberholser, H. C. 1974. *The bird life of Texas*. Vol. 1. University of Texas Press, Austin, TX.

Defines *tenuirostris* as including Gulf coastal northeast Mexico and Texas as well as the Texas interior panhandle population along with the ranges described by other authors.

Page, G. W., J. S. Warriner, J. C. Warriner, and P. W. C. Paton. 1995. Snowy plover (*Charadrius alexandrinus*). In *The Birds of North America* No. 154 (A. Poole and F. Gills, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

A comprehensive species account with information on all 3 subspecies of Snowy Plover found in North America including information on distribution, breeding, feeding and diet, conservation and management, behavior, and appearance of Snowy Plovers. *Charadrius alexandrinus tenuirostris* can be found primarily on the Gulf Coast (east of Louisiana), Bahama Islands, northern Yucatan Peninsula, Greater and Lesser Antilles, and islands of the north coast of Venezuela. Some populations of *C. a. nivosus*, the western subspecies, are considered Threatened by the federal government. The third subspecies *C. a. occidentalis*, is found on the west coast of South America.

Paton, P. W. C. 1999. A closer look: Snowy plover. *Birding* 31:238-244.

A general, popular overview of Snowy Plovers in the United States with descriptions of distribution, status, life history, and habitat selection of Snowy Plovers. Also included are conservation concerns and threats facing the Snowy Plovers survival which include habitat loss from shoreline development, off-road vehicles, and overabundant fox populations.

Paton, P. W. C., and T. C. Edwards Jr. 1996. Factors affecting interannual movements of Snowy Plovers. *Auk* 113:534-543.

Snowy Plovers tend to return to the same area year after year to breed. Effects of overall nest density at a site, overall hatching success at a site, and an individual's

nesting success the previous year were studied. Female Snowy Plovers were less likely to return to a site if they had nested unsuccessfully there the previous year. Nest success did not seem to affect site fidelity in males.

- Powell, A. N. and C. L. Collier. 2000. Habitat use and reproductive success of western Snowy Plovers at new nesting areas created for California least terns. *Journal of Wildlife Management* 64:24-33.

The creation of nesting habitat from dredged materials for California Least Tern has added new habitat for Snowy Plovers as well. The fledge rate was greater at the newly created areas compared to older dredged-material areas, possibly due to lower numbers of predators at newly created areas. These areas mimic the creation and loss of beaches and sandbars through natural processes. The dredged-material areas were not only used for nesting by Snowy Plovers but also during the winter for foraging and resting. People and their pets rarely disturb these areas.

- Rupert, J. R. 1997. The brood-rearing habitat, brood home range, and fecundity of the Snowy Plover (*Charadrius alexandrinus*) in coastal southern Texas. M.S. thesis. University of Texas-Pan American, Edinburg, TX.

Snowy Plovers nests in Least Tern colonies had a significantly greater chance of hatching than nests not in Least Tern colonies. Predation was the most common cause of nest failure, but the placement of plover nests in tern colonies helped to protect the nest against predation. A habitat change from nest site to brood area was also observed. Nests were most commonly found in open flat areas while broods occurred in areas with significantly higher vegetative cover, possibly to provide cover from predators.

- Sibley, C. G., and B. L. Monroe, Jr. 1990. Distribution and taxonomy of birds of the world. Yale University Press, New Haven, CT.

Recognizes only *nivosus* and *occidentalis* as New World forms of Snowy Plover.

- Sprandel, G. L., J. A. Gore, and D. T. Cobb. 2000. Distribution of wintering shorebirds in coastal Florida. *Journal of Field Ornithology* 71:708-720.

Summary of status and distribution of wintering shorebirds in Florida. The abundance of shorebirds varied by species among the coastal regions. Florida is an important wintering site and supports many shorebirds including the Gulf Coast populations of Snowy Plovers. The wintering population was 101 birds at 25 sites.

Stevenson, H. M. and B. H. Anderson. 1994. *The Birdlife of Florida*. University Press of Florida, Gainesville, FL. pp 211-213.

This account documents recorded breeding, migration, and observation data on Snowy Plovers throughout Florida, with a map of specimen records and site reports. The account refers to the Snowy Plover as a locally rare to uncommon breeding resident along the Gulf coast.

Stolen, E. D. 1999. Occurrence of birds in beach habitat in east-central Florida. *Florida Field Naturalist* 27:77-136.

Large numbers of birds depend on coastal Florida as wintering sites or stopover sites on the way to the West Indies or South America. Undisturbed beach is disappearing. Conservation efforts should make preservation of undisturbed waterbird habitat a priority.

US Fish and Wildlife Service. 2001. 2001 Florida Piping Plover (and Snowy Plover) winter census. Unpublished report, US Fish and Wildlife Service, Panama City, FL.

A synopsis of the 2001 International Piping Plover Survey results for Florida. The 2001 survey included Snowy Plover. The total state wintering population estimate was 304 with 68% in seven panhandle counties.

Winton B. R., D. M. Leslie Jr., and J. R. Rupert. 2000. Breeding ecology and management of Snowy Plovers in North-central Oklahoma. *Journal of Field Ornithology* 71:573-584.

A study performed in an area where habitat improvements and electric-fence predator exclosures were used to increase nest success of Snowy Plovers. Gulls and canids were the primary nest predators. Flooding also caused significant loss of nests. Snowy Plover nests were frequently associated with driftwood and other debris although this seems to attract predators and reduce nest success.

Zonick, C. 1997. Snowy plover breeding ecology along the Texas Gulf Coast. Attachment A, Report to the Texas Parks and Wildlife Department and the U. S. Fish and Wildlife Service.

Investigations of the breeding ecology of Snowy Plovers along the Texas Coast. Snowy Plovers preferred nesting in shell covered microhabitat and lined their nests with shells possibly as camouflage. This appears to have increased predation by mammals, as mammalian predators concentrate their nest searches in areas with shells. Depredation by mammals and vehicular crushing were the two highest causes of nest loss during this survey.

Zonick, C. 1997. The use of Texas barrier island washover pass habitat by piping plovers and other coastal birds. Attachment B, Report to the Texas Parks and Wildlife Department and the U. S. Fish and Wildlife Service.

The Cuban Snowy Plover, *C. a. tenuirostris*, was observed congregating with the Piping Plover in large diurnal roosts in washover passes. These passes are thought to be critical winter habitat for the two plover species. Also a large portion of the Snowy Plover population on Texas barrier islands appeared to concentrate in washover passes during the breeding season. Washover passes are relatively vegetation free and are infrequently disturbed by humans. Least Terns and Snowy Plovers were both observed to prefer the shell field microhabitat when breeding.

Appendix 7. Recent literature relevant to the Florida snowy plover population.

- Elliott-Smith, E., S.M. Haig, C.L. Ferland, and L.H. Gorman. 2004. Winter distribution and abundance of snowy plovers in SE North America and the West Indies. Wader Study Group Bulletin 104:28-33.
- Gorman, L. R. and S. M. Haig. 2002. Distribution and abundance of snowy plovers in eastern North America, the Caribbean, and the Bahamas. J. Field Ornithol. 73(1):38-52.
- Neuman, K. K., G. W. Page, L. E. Stenzel, J. C. Warriner, and J. S. Warriner. 2004. Effect of mammalian predator management on snowy plover breeding success. Waterbirds 27(3):257-263.
- Ruhlen, T. D., S. Abbott, L.E. Stenzel, and G. W. Page. 2003. Evidence that human disturbance reduces snowy plover chick survival. J. Field Ornithol. 74(3):300-304.